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THE

TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. IX.—1881.

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AND

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THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. IX.—No. 190.

1880.

THE year 1880 has been more particularly marked by the progress which has been made in the electric light and the telephone. Comparatively little has been done in the way of startling novelties in these branches of electrical science, though their practical adaptations have been strikingly rapid. The use of the electric light has been extended in a progressive manner, and the confidence of the public in it has become nearly complete, and it has almost ceased to be looked upon as a novelty. In spite of this advance, the welfare of the gas companies does not appear to have suffered; and a year of undeniable and steady progress of the electric light in this country has done less to affect the value of gas stock than did the unconfirmed rumours of success which were cabled from America. Whether the formation of large and influential electric light companies in this country will again cause a scare to be produced remains yet to be seen; but the fact that the shares in these companies are being largely subscribed for shows that the public are quite alive to the growing importance of the electric light. The coming trial of the light in the City of London will go far to insure its more extensive adoption.

The spread of the telephone system in all the large towns of the United Kingdom has been effected with astonishing rapidity, and though possibly the recent decision of the Exchequer Court in favour of the Government will check to a certain extent further operations at the hands of the companies, the invention has proved such a necessity for business that its extension at the hands of the State will no doubt be very great. The instrument which up to the present has given the best results is the Gower-Bell telephone, whose success dates from the past year.

The telephone patents taken out in 1880 are fairly numerous, though at the present time the ardour of inventors has somewhat abated. Amongst the transmitters may be mentioned that of Theiler, which has been adopted by the Swiss Government.

The electric light patents have been very numerous; but, again, in this branch of invention, enthusiasm has somewhat abated of late.

As regards the electrical patents taken out during the year ending December 4, the total number is no less than 270, a fact which indicates fairly the amount of interest taken in electrical matters, and may be taken as indicative of the part which electricity is likely to play in the future in every branch of the arts.

Amongst the electric light systems, the Jablochkoff, Brush, and Siemens continue to hold the first place, whilst the systems of Lontin, Jamin, Werdermann, and especially Crompton, are vigorously pushing their way. The lamp of Mr. Brockie is a distinct departure from the ordinary method of regulation, and promises good results. More recently the experiments of Mr. Swan, of Newcastle, who has been working quietly at the incandescent system, have excited considerable interest. The Swan system seems admirably adapted for domestic purposes.

Apropos of the gas question, the use of gas-engines for driving the dynamo machines and for other purposes is becoming very considerable. A new field for the use of gas is thus opened.

In dynamo machines but little has been done, though several new forms have been suggested, but not yet brought into practical use.

Next to the telephone and the electric light, the application of electricity to the production of motive power has excited the greatest interest, and especially the branch of the question which has reference to railways. Dr. W. Siemens has brought the subject very prominently forward, and at the present time several short lengths of electrical railways are in contemplation or construction. The question seems likely to be of considerable importance.

Dr. C. W. Siemens' experiments on the effect of the electric light upon vegetation have shown that the forcing of plants and vegetables could be considerably stimulated by artificial illumination, and according to calculation it seems even probable that the process would be a profitable one.

The introduction of electrical fire-alarms has at last been taken up in earnest by the City of London authorities; at the present time two systems have and are being submitted to a thorough trial. The one is the Exchange, and the other Bright's system.

During the year several sittings have been held by the Lightning-rod Committee appointed by the Society of Telegraph Engineers, and a report upon their deliberations is promised before long.

A committee has been appointed by the British Association to revalue the ohm.

In experimental work, undoubtedly the most remarkable discovery of the year has been the Photophone of Professor Bell, in which the action of light has been to produce sound. It is difficult to say at present whether any practical results will arise from the remarkable discovery.

Professor Minchin's experiments upon the action of light in producing currents of electricity have been very original and interesting.

In telegraphy no very marked improvements have been manifest, though a good deal of quiet work has been done. The papers read before the Society of Telegraph Engineers have been of considerable interest, and show that the society is doing useful work. The opening of the Ronald's library has put into the hands of the public a most valuable source of scientific information which it is hoped will be duly appreciated.

The laying of a seventh Atlantic cable, making four in working order, has been effected during the year, and several short lengths have been laid, but the successful carrying out of such works is now such a matter of course that but little scientific interest is aroused.

The City and Guilds Institute is now fairly started and is doing excellent work in all branches of physical science as applied to the arts, electricity and telegraphy not being neglected.

A FIRE ALARUM APPARATUS.

By T. M. BANKER.

This fire alarum is arranged on the metallic circular system giving the call on an ordinary indicator, using only one wire with a permanent current. The permanent current is greatly reduced in strength by means of a resistance coil which is inserted in the line when the circuit is in its normal condition, so as to retard the usually quick exhaustion which occurs when the batteries are constantly working through a small resistance such as constitute a fire alarum circuit.

The apparatus at the fire station consists of a switch, indicator with bell, resistance coil, push button, and batteries. By referring to the sketch the following explanation will point out its action :— Switch : ratchet wheel, *a*, is on the same spindle as the wheel, *b*, the latter having its face towards *c*, cut with ratchet teeth, *c* also having its face towards *b* cut with ratchet teeth of the same pitch as *b*, so that when the two wheels are together they fit each other and form a clutch. The wheel, *c*, is fixed on a spindle whose axis is in the same line with that of *a*, *b*, and is free to move in its bearings for a short distance longitudinally, so as to free itself from *b* when required. On the same spindle as *c* are two collars, *e*, between which the forked end of the armature lever of the electro-magnet, *g*, plays and imparts the longitudinal motion to the spindle in one direction or the other, as the armature of *g* is attracted or released, hence makes or breaks the clutch between *b* and *c*. At the extremity of the same spindle is an arm, *d*, weighted so that when the clutch is separated it at once drops down into a vertical position forming its normal condition ; this arm as it is carried up forms circuits in succession through the indicator by means of springs, each spring being connected to a different hole of the indicator ; the rachet wheel, *a*, receives its motion in the direction of the arrow from the detent attached to the end of the lever belonging to the armature of the electro-magnet, *f*, and is prevented from a retrograde motion by a second detent not shown in sketch. The battery, B, is divided into two parts having the resistance coil, R, inserted between the parts, and when necessary the resistance can be cut out of circuit by pressing in the button of push P.

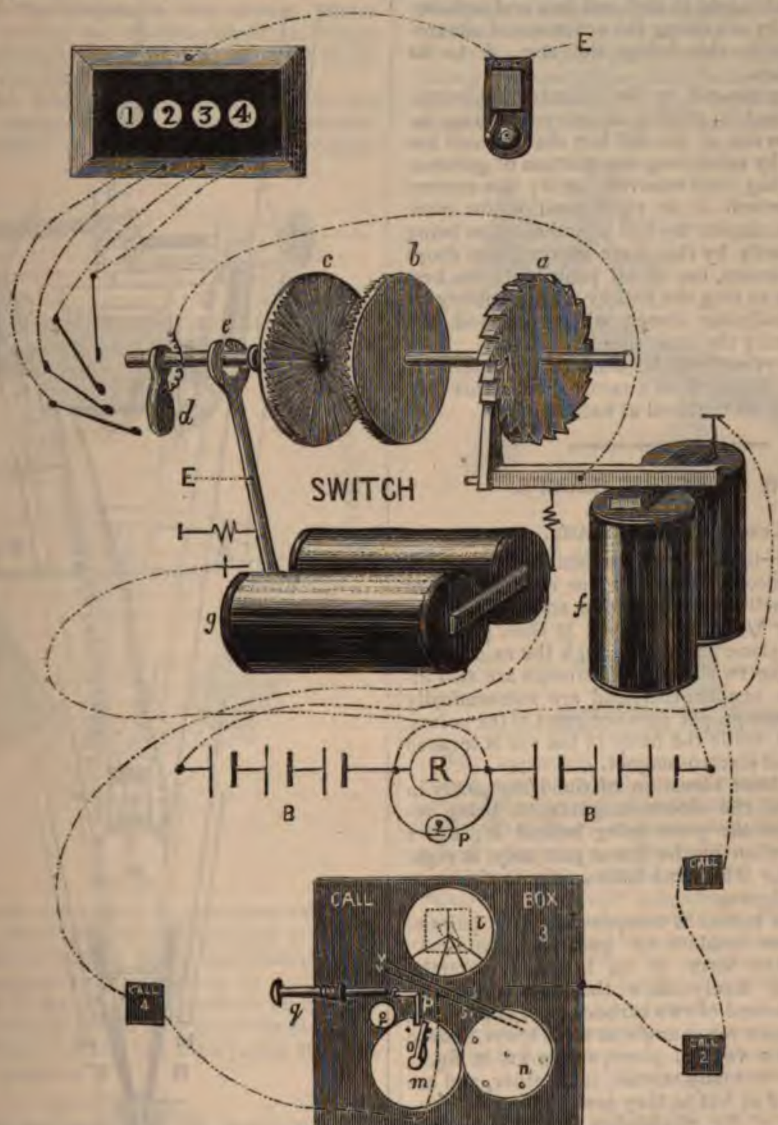
The call box, which can be placed in a niche in almost any wall or street post, may be made to occupy a very small place, as the mechanism need not be large or cumbersome. When the knob, *q*, is pulled out it sets the train work in motion, and the act of pulling out the knob also winds up either a spring or weight sufficiently to actuate the mechanism for giving the signals, and as soon as the signals have been delivered the knob, which was locked on being pulled out, returns to its former position, stopping the train work, therefore it is always ready for use, being entirely automatic in its action. The knob, *q*, is locked out by means of one end of a bell crank lever, *p*, dropping against its end, and held tight in this position by the spiral spring surrounding the spindle of *q*. The drum, *m*, which is wound up by the action of pulling out the knob, *q*, has on its arbor a lever, *o*, that revolves with *m*, having its play limited by two stop pins, against the left of which it is gently held by a slight spring until it meets with the lower arm of the bell crank lever, *p*, where the pressure becomes sufficient to overcome the strength of the spring and carries it to the right-hand stop pin, here it commences to press up the bell crank lever, *p*, until it liberates the knob, *q* ; on accomplishing this the lever, *o*, is pressed again against the left-hand stop pin by its spring, so that if the knob should be pulled out again immediately after returning to its usual position the mechanism can at once commence to repeat its signals. Wheel *n* is in gear with *m*, and, connected to the earth, has on one side of it as many contacts as are required to lift the arm, *d*, of switch to the spring in connection with its hold of the indicator, whilst on the other side it has a contact following the others which drops the indicator and rings the bell. Wheel *r* has the fly on its arbor and also the friction roller of the break for stopping the train work. The galvanometer, *t*, is constructed on the single needle principle, with a circular disc in place of the usual indicating needle, having a quadrant of it divided into three differently coloured segments, so as to correspond to the three different electrical states of the wire—that is, when no current is passing or the knob has been pulled out, the magnet of the coil would hang vertically and show the word "engaged" on the disc. When the resistance coil, R, is in circuit the amount of current passing would expose that part of the disc having the words "ready for use" on it. After a call has been received, by pressing in the button of push P, throwing all the current on the line, that portion of the disc having "call received" would appear. Pulling out the knob, *q*, also disconnects the galvanometer belonging to that box from the line by releasing the two springs, *s*, s^1, from the contacts attached to the ends of the coil wires, but is again put in circuit on the knob returning to the normal state.

The electrical connection from the right-hand side or zinc end of the battery, B, passes through the electro-magnet, *f*, then through all the galvanometers of the call boxes, 1, 2, 3, 4, on the circuit to the electro-magnet, *g*, returning to the copper end

or left-hand side of the battery. Attached to the right-hand side of the resistance coil, R, placed in centre of battery, is a wire going to the upper limiting stop of lever of electro-magnet, *g*, while the lever itself is connected to the earth, but insulated from other parts of the apparatus. On the left-hand side of the resistance coil, R, is another wire going to the upper limiting stop of the lever of the

bringing the armatures to the coils. The wires attached to the upper limiting stops of the electro-magnets are insulated when both armatures are on their coils.

When the circuit is broken—say at the call box 3, by pulling out its knob—both electro-magnets lose their magnetism, and the armatures are pulled away from the coils by their respective spiral springs



electro-magnet, *f*, while the lever itself, which is insulated from other parts of the apparatus, has a wire going to the insulated arm, *d*.

When the circuit is in working order, but not working, both armatures of the electro-magnets, *f*, *g*, are held down (thereby separating the clutch, *b*, *c*) by the reduced current on line; this reduced current is sufficient to hold the armatures to the coils, but not sufficiently powerful to do the work required in

to their upper stops, putting the right-hand wire to earth, and the left-hand wire to earth through the indicator, after the first signal has been received from the right-hand wire. The clutch, *b*, *c*, also joins, so that on the train work in box 3 running it would put the right-hand wire to earth by means of the spring, *s*, making earth on the contacts on the wheel, *n*, causing the right-hand portion of the battery, B, to magnetise the electro-magnet, *f*, pull-

ing down the armature and moving the ratchet wheel, *a*, forward as many teeth as there are currents sent, and in so doing the arm, *d*, is carried up by means of the clutch, *b*, *c*. When the number of contacts belonging to this special call box has been made, the left-hand side of the wire is put to earth by means of the spring, s^1, and wheel, *n*, causing the left-hand portion of the battery, B, to drop the indicator screen belonging to that call box, and separating the clutch by attracting the armature of electro-magnet, *g*, which also brings the arm, *d*, to its normal condition.

On receiving the call on the indicator the button of push is pressed in, putting all current to line, informing the person at the call box that the call has been received by exhibiting that portion of galvanometer disc having "call received" on it; this current also sets the switch in its right position for work again. I have shown the bell of indicator as being rung momentarily by the same current that drops the indicator screen, but in all probability the best plan would be to ring the bell by a local battery by making the indicator screen when dropped the means of forming the local circuit.

The same system can be used on a single wire, making use of the earth as a return, but in this case batteries would be required at each call box.

NEW ELECTRIC LAMPS.

LESCUYER'S ARC LAMP.

THE peculiarity in this lamp consists in the arrangement of the electrodes, which are each formed of two carbons inclined towards one another so as to form the letter V, and so shaped at their points as to meet in a plane passing through the axis of the apparatus. The two double electrodes are also inclined towards one another, and are automatically maintained at the proper distance apart at the points, by mechanism, while the fixity of the arc is insured by a fan-shaped electro-magnet.

Fig. 1 is a front elevation of the lamp partly in section, one of the electro-magnets, N, being removed to show the parts lying behind it; fig. 2 shows an elevation of the lower part only, at right angles to fig. 1. The same letters refer to the same parts in both figures.

The lamp or burner is composed of two pairs of tubular carbon holders or guides, A, A, A^1, A^1, arranged in the form of an inverted pyramid, through which freely slide the two electrodes respectively formed of two carbons, B, B, and B^1, B^1, bevelled off to an acute angle at their lower ends so as to meet in a vertical plane, as shown in fig. 2, whereby they mutually sustain each other, and are free to descend as fast as they are consumed.

The whole of the mechanism is mounted on a plate, C, to a flange at one end of which the pair of tubular holders, A, A, is permanently attached, a plate of vulcanite, E, being interposed to insulate the holders from the plate. The other pair of holders, A^1, A^1, are hinged at D to the opposite end of plate, C. By means of a set screw, F, the interval between the points of the electrodes may be regulated according to the tension of the current and the length of the arc it is desired to obtain, the said interval being maintained by a spring, G, the tension of which may be regulated as required by a screw, H. I is an electro-magnet placed in a derivation of the current passing through conducting wires, J, J, and K is its armature attached to the carbon holders, A^1, A^1; L, binding stud, to which one of the conducting wires from the generating machine is attached, the other wire being connected to a second stud behind the first; M, M, are gun metal

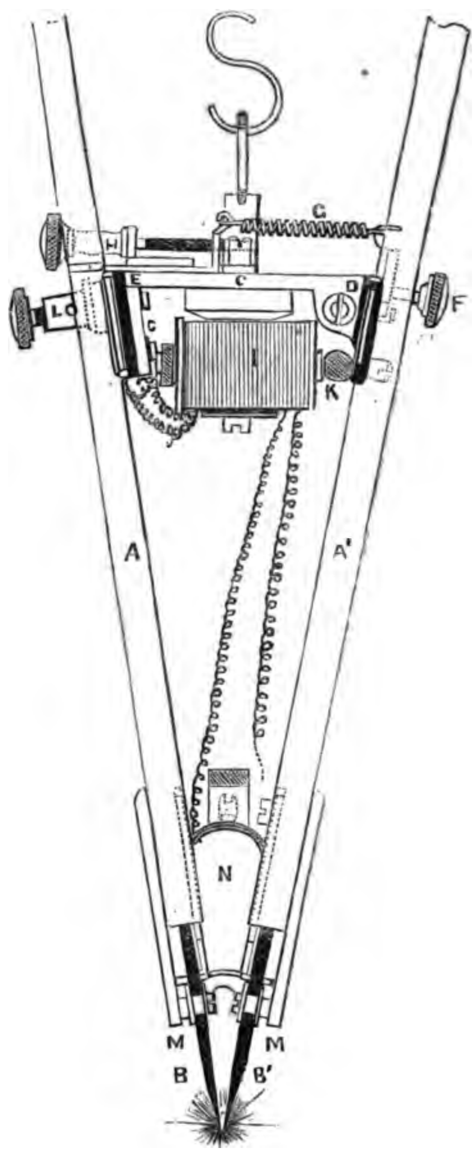


FIG. 1.

rollers, which serve both to guide the carbons and to establish electrical contact between the holders and the carbons near their points, in order that only a short length of the carbon shall be included in the circuit; N, N is a fan-shaped electro-magnet, through which the current passes before entering the carbons, curved prolongations of the cores of the magnet being arranged with regard to the carbons, as shown,

in order to prevent the voltaic arc rising between the electrodes. O, suspension hook.

The action is as follows :—The distance between the point of the double electrode, B, B, and that of the double electrode, B^1, B^1, is first regulated by screw, F, and the binding screws, L, L, are then connected with the two poles of the generating machine. As communication is not yet established between the points of the electrodes the current passes through and excites the electro-magnet, I, which attracts its armature, K, and brings the points of the electrodes in contact with one another.

The current then passes to the points of the carbons, and ceases to flow through the electro-magnet, I, which being demagnetised, releases

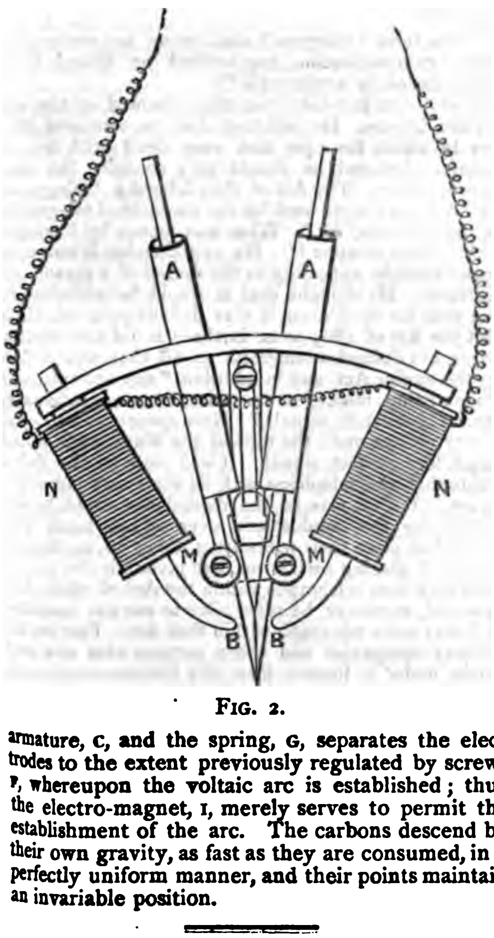


FIG. 2.

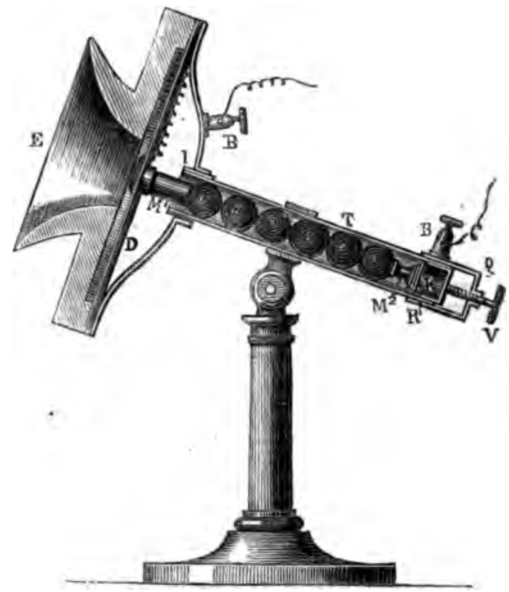
armature, C, and the spring, G, separates the electrodes to the extent previously regulated by screw, F, whereupon the voltaic arc is established; thus the electro-magnet, I, merely serves to permit the establishment of the arc. The carbons descend by their own gravity, as fast as they are consumed, in a perfectly uniform manner, and their points maintain an invariable position.

NEW MICROPHONE OF M. BOUDET, OF PARIS.

THIS microphone, with multiple contacts, is represented by the figure. It is composed of a mouthpiece, E, fixed at the extremity of a tube of glass, T, of a centimetre in diameter, and fixed on a jointed stand which allows the tube to be set at any convenient angle.

The mouthpiece carries an ebonite plate 1 millimetre thick, upon which is fixed a mass of copper, M^1, which penetrates a short distance into the glass tube. In this tube six horn carbon balls are placed whose diameters are slightly less than that of the tube, so that they can move freely.

The microphone is completed by a second mass of copper, M^2, set in a cup, K, which slides in the tube and can be adjusted by a set screw, V, and a spring (not shown). The screw, V, fixed on the bridge piece, A, serves to regulate the pressure of the mass, M^2, against the balls. The variations of resistance of the microphone are produced equally on all the contacts of the balls, because, in speaking before the mouthpiece, the vibrations are transmitted almost instantaneously, as in the well-known experiment with a number of billiard balls.



The apparatus works like an ordinary microphone, with six medium size Gaiffe cells (peroxide of manganese and chloride of zinc) joined up in series through a resistance of 800 ohms,* and with a Bell telephone as a receiver.

In employing *induced* currents and a telephone receiver wound with fine wire—a condition necessary with induced currents—the distance can be considerably extended, with artificial resistances, up to 250,000 ohms.

We have assisted at some experiments made with this microphone, and we have noticed that it transmits the voice very clearly, without changing its quality and without gratings.—*La Nature.*

THE EFFECT OF TEMPERATURE ON THE INSULATING VALUE OF PARAFFIN OIL.

WE have been favoured by Mr. David Brooks with the results of some experiments made by him on the effects of temperature on the insulating value of paraffin oil as used by him in his system of underground wires. The experiments were made as

* Practically a resistance of 1 ohm represents that of a pure copper wire 1 millimetre in diameter and 48m. 5 long, or about 40 metres of ordinary copper wire of a similar diameter; or still further, 97 metres of iron wire 4 millimetres in diameter (ordinary telegraph wire).

ollows :—Two plates of tin of twenty-five square feet superficial arc were placed one-eighth of an inch apart and insulated from one another by a layer of the paraffin oil. The temperature of the oil and plates was raised to 200° Fahr., and allowed to cool slowly. In the circuit of the plates were 300 Daniell cells and a Thomson galvanometer. The following were the deflections obtained at the various temperatures :—

Temperature—Degrees.		Deflections.	Temperature—Degrees.		Deflections.
200	...	325	130	...	35
195	...	280	125	...	30
190	...	260	120	...	26
185	...	230	115	...	22
180	...	180	110	...	20
175	...	155	105	...	17
170	...	125	100	...	15
165	...	105	90	...	12
160	...	90	80	...	10
155	...	75	70	...	8
150	...	60	60	...	6
145	...	50	50	...	5
140	...	45	40	...	4
135	...	40			

It was noticed that the electro-static capacity of the arrangement was not varied in the least by the change of temperature.

THE RONALD'S LIBRARY.

THIS magnificent collection of electrical works now secured to the Society of Telegraph Engineers is open at 4, Broad Sanctuary, Westminster, under the following rules:—

RULES.

1.—That the library be open to members of all scientific societies, and on application to the librarian to the public generally.

2.—The library is open daily between the hours of 11 a.m. and 8 p.m., except on Thursdays and Saturdays, when it closes at 2 p.m.

3.—The library will be closed from August 15th to September 15th, both inclusive, and on all public holidays.

4.—The library is to be used for reference only, and no books, pamphlets, or patent specifications are allowed to be taken from the library.

5.—All works are to be returned to the librarian or his assistant, and are *not* to be replaced on the shelves by the readers.

By Order of the Council,
A. J. FROST, *Librarian.*

From the 1st January, the collection will be opened practically as a free public library till 8 in the evening for four days in the week.

The library contains all the principal scientific periodicals, and arrangements have been made to have all the published specifications relating to electricity immediately after publication.

Mr. Latimer Clark has placed his magnificent collection of electrical works at the disposal of the members of the society, so that they can be seen at his office on application.

THE TELEPHONE CASE.*

In the High Court of Justice. Exchequer Division.

Before MR. BARON POLLOCK *and* MR. JUSTICE STEPHEN.

THE ATTORNEY-GENERAL *v.* THE EDISON TELEPHONE COMPANY, LIMITED.

(*Continued from Vol. VIII., page* 429.)

[IN our analysis of the Information, paragraph 3, the following definitions from the 32nd and 33rd Vic., cap. 73, sec. 3, were accidentally omitted :—

"The term 'telegraph' shall, in addition to the meaning assigned to it in the Telegraph Act, 1863, mean and include any apparatus for transmitting messages or other communications by means of electric signals."

"The term 'telegram' shall mean any message or other communication transmitted or intended for transmission by a telegraph."]

The SOLICITOR-GENERAL then summed up the case for the Crown. He said that after the complete manner in which the case had been dealt with by the Attorney-General he should only consider the more salient points. The Act of 1863 defined a "telegraph" as "a wire or wires used for the purposes of telegraphic communication, &c." What was meant by "telegraphic communication?" He apprehended it was communication by appealing to the senses of a person at a distance. He thought that it would be sufficient for the case for the Crown if that definition stood alone. But the Act of 1869 went further; it did not mention wires, but defined a telegraph as all that was defined by the earlier Act, and in addition "any apparatus for transmitting messages or other communications by means of electric signals." Now speech was a signal, a very perfect one: the taps of the Morse code were a much less perfect signal. It was said by the defendants that the telephone with its wires was not a telegraph. If that was so the defendants could be forbidden by the landowners over whose lands they desired to place their wires from doing so, as the only power of placing such wires was given on the ground that they were telegraphs within the Act of 1863. And it would, moreover, be *ultra vires* to use the telephone if it was not a telegraph within that Act. Further, the railway companies and those persons who now used wires under a licence from the Postmaster-General, could, by changing their instruments to telephones, laugh at him and evade the monopoly bought at so high a cost. It is said by the defendants that the telephone differed from the instruments that preceded it, as its action depended on different properties; but the same remark may be made as to the needle instruments and the electro-magnetic instruments. Then, again, it is said that with the telephone you have no arbitrary code, and that is said to prevent it from being a telegraph. But suppose one uses the telephone with Morse symbols, would it cease to be a telephone? Yet it would be a telegraph. One could make that code by long and short Ohs! then sing, then speak, where would you draw the line?

Mr. JUSTICE STEPHEN.—Suppose a telephone could not produce a Z. If you sounded D in its place would that make the symbols employed arbitrary?

The SOLICITOR-GENERAL.—As to the scientific evidence, one might well set off one set of scientific men against the other. But why do they say this is not a telegraph? Because it depends on a different

* Specially reported for this JOURNAL by A. B. KEMPE, Esq., Barrister-at-Law.

principle to that of preceding telegraphs. But then Dr. Fleming says that the telephones of Bell and Edison are dependent on different principles; so that if his argument is sound, if Bell's telephone were a telegraph Edison's would not be. No such line can be drawn between any two instruments. The invention of them is a matter of gradual development. At the time of the passing of the Act of 1869 considerable progress had been made. Charles Bourseul had given his ideas to the world. Reis had made his discovery, and Yeates had succeeded in making the voice recognisable at the receiving station. It was clear that the idea of variation, as distinguished from interruption, was known and published by Mr. Varley and Sir W. Thomson, and was turned to actual use in submarine cables. As to the contention that the Company's operations came within the exceptions to the monopoly, that must be argued as if the instruments used were admitted to be telegraphs. The payment made by the subscribers was not only for the use of the wire, but for the services rendered by the switch-boy in connecting the wires, a service which the Company could be compelled to render. It is clear that the subscriptions are in effect a composition in lieu of a payment for each message.

Mr. Benjamin, in addressing the Court for the defendants, pointed out that the Postmaster-General had no monopoly of apparatus. His monopoly was solely that of transmitting messages. The preamble of the Act of 1869 indicated the nature of the monopoly. It was to be similar to the monopoly granted in respect of the conveyance of letters by the Act 7th Will. IV. and 1st Vic., cap. 33. That statute made certain exceptions from the monopoly, such as letters conveyed by a friend, or by a messenger employed expressly for the sender's own purposes. There was, however, no exception made in favour of a man carrying his own letters. The reason for that was that the case was not regarded as coming within the monopoly granted, and did not, therefore, require to be excepted. The monopoly was, in fact, that of the employment of intermediaries to convey or transmit the communications of one person to another, and that is also the monopoly granted by the Telegraph Act of 1869. It was never intended that the Postmaster-General should, as had practically been contended, have the monopoly of speech between any two of Her Majesty's subjects. The tactics of the other side had been to pull the unfortunate Mr. Edison's invention to pieces, and to make out that there was nothing new in it. That was not so. The thing was new. In 1869 a "telegraph" was a well-known thing, it was a contrivance for communicating between two persons at a distance by means of a preconcerted code agreed upon by sender and receiver. No author had been or could be cited to show it had any other signification. An author of eminence, M. Jamin, in his "Cours de Physique," vol. iii., page 330, says, in 1869, "La transmission télégraphique exige trois choses: 1° un fil conducteur qui réunit les deux stations et que l'on nomme *fil de ligne* ou simplement *ligne;* 2° un instrument qui lance et interrompt l'électricité dans les conditions déterminées et suivant une signification convenue à l'avance, c'est le *manipulateur;* 3° un autre appareil, le *recepteur,* qui reçoit à la seconde station les signaux envoyés de la première." That clearly shows that it is necessary to have a preconcerted code, and a "making and breaking" of current in order to constitute a telegraph. The telephone required no code and no "making and breaking." Again, Mr. Preece, in a lecture delivered by him [Free Evening Lectures on Scientific Apparatus. Chapman & Hall, 1876] at the South Kensington Museum, had defined telegraphy as "the art of conveying to distant places by the aid of the ear or the eye the first elements of written language. It does not convey from place to place ideas, but the letters of the alphabet and numerals, so that the different systems of telegraphy simply consist in the different ways in which the letters of the alphabet are formed. When that is done by electricity, we have the electric telegraph." And again, after describing the variations of tone created by a boy whilst whistling a tune, he proceeds: "We cannot, in telegraphy, make use of all those variations of tone; we are reduced to simply two notes, one called a *dot*, which is equivalent to a quaver in music; and the other called a *dash*, which is equivalent to a crotchet." That is, in other words, exactly what M. Jamin says, so the two authorities agree. Turning to the statute of 1863, he argued that it was clear from that statute that what was meant by a "message" was a material thing which could be collected, marked, stamped, and deposited. A speech could not be "marked," as was directed in certain cases by the statute. By sec. 21 the property in a message was laid in the Postmaster-General, that clearly implied something material. Wherever the word "communications" was used, it referred to press despatches, which it was no doubt thought could not be properly termed "messages." The Act of 1869, whenever it deals with a private person, always speaks of him as having the "use" of the line, not as sending telegrams. As to sec. 3 of that Act, and its use of "electric signals," no one could say that speaking through a telephonic circuit was signalling, if so, direct speech would be signalling, a *reductio ad absurdum.* The whole idea of transmission implies an intermediary. When one person speaks to another he does not transmit a communication to the latter. The Postmaster-General was claiming a monopoly, and a monopoly should be brought within as narrow limits as possible; and it would be extending the grant to say that it was to apply to cases where there is no "telegram," no transmission of any message by an intermediary, but only direct speech between A and B. The learned counsel then proceeded to point out that at any rate the Company fell within the exceptions of sec. 5 of the Act of 1869. It was clear that since the passing of Lord Brougham's Act (13 & 14 Vic. cap. 21, sec. 4), for shortening Acts of Parliament, which says singular is to include plural, the word *owner* in the exceptions must be read so as to include *owners.* When this is done, we have excepted "telegraphs maintained or used solely for the private use . . . of the owners," *i.e.*, the present case. No charge is made by the Company in respect of "collection, receipt, transmission, or delivery," they merely sell or lease apparatus.

At this point the learned counsel, whose voice failed him from hoarseness, was permitted to postpone the remainder of his argument until after Mr. Webster had addressed the Court.

Mr. Webster, following on the same side, said that he must protest against the attempt that had been made to get the Acts of Parliament, upon which the case turned, construed in the light of the expressions which appeared in Mr. Edison's specifications. The Company were not Mr. Edison, and had only a licence from him, and what Mr. Edison had said could not bind them. An attempt had been made to decry the invention, but he challenged the Attorney-General to produce from the annals of patent cases a single case of so perfectly new a result produced by such entirely new means. Before the invention of the telephone the human voice had never been conveyed by wire. All the arguments that had been urged as to the sounders failed, because the sound was produced at the receiving end, and was not generated by the transmitter. It is

obvious that a patent for a monopoly of telegraphic instruments would not cover the telephone. We should have the Postmaster-General claiming the photophone next. Previous telegraphs differed in degree, the telephone differed from them in kind.

Sir J. STEPHEN.—That is too subtle. I once heard a learned debate as to whether the difference between differences of kind and degree was one of degree or kind.

Mr. WEBSTER said that former telegraphs merely signalled, the telephone extended the limits of speech. He then proceeded to deal with the various sections of the Acts of Parliament. He gathered from them that a "message" was something intended to be intrusted by the sender to an intermediary for conveyance, by whatever means, to the receiver. By sec. 15 of the Act of 1868 telegrams are to be charged for by *words*. How could that apply to telephonic communication? The Company merely grant access to certain apparatus for which they make an annual charge. They receive no money in respect of messages or other communications. He also argued that the operations of the Company were within the exceptions.

The telephonic apparatus and mode of operation were then exhibited in Court. In the course of the exhibition, at the request of the Attorney-General, the sentence "a swan was sailing over the sea" was spoken through the circuit. It issued in unmistakable tones as "a wan was wailing over the wee," but a subsequent sentence, "she shut up shop on Sunday," came out equally clearly with the s's correctly pronounced. This was explained to be merely a question of adjustment.

Mr. BENJAMIN then continued his argument. In order to show what was the view of scientific men of ability and knowledge of the subject as to the nature of the telephone he, after some objection by the Attorney-General, read portions of a lecture on the telephone delivered by Mr. Preece at the Royal Institution on February 1st, 1878. Mr. Preece there stated that, "The telephone is an instrument constructed for the transmission of sound to a distance." He (Mr. Benjamin) then asked when the Postmaster's monopoly is infringed. The Company do not ever know whether people are speaking along the wires or not. In order to save wire they adopt the ingenious "exchange system," which requires that they shall when necessary disconnect certain subscribers and connect others. Is that transmitting a message?

The ATTORNEY-GENERAL then replied. He repudiated the idea of having any intention to depreciate the beautiful invention of the telephone. He had done no more than point out its connection with other telegraphic instruments. As to the argument that the monopoly must be construed strictly, he knew of no such rule. Indeed, as the monopoly was for the public benefit it ought if anything to be dealt with in a large and liberal spirit. If the contention of the defendants were correct, that they were owners of a private telegraph within the exceptions, people might club together to any extent and entirely destroy the monopoly. The main points had not been dealt with by the defendants' counsel. They were the existence of the trunk lines and the operations of the switch-boy. How could the Company say that the wires belonged to the individual subscribers or that the Company did not aid in the transmission of messages?

At the conclusion of the Attorney-General's address the Court said they would take time to consider their judgment.

Judgment was delivered on Monday, 20th December. It was in writing, prepared by Mr. Justice Stephen and agreed to by Mr. Baron Pollock.

Mr. JUSTICE STEPHEN, after stating the facts of the case and citing the various definitions of "telegraphs" and "telegrams" contained in the Acts, proceeded to state what the contentions on either side were, and cited various passages from the affidavits, concluding with those which referred to the question, whether sound could be said to be "transmitted" by telephonic apparatus. He then proceeded: We do not think it necessary to express any opinion on a controversy which is more scientific than legal, and perhaps more properly metaphysical or relative to the meaning of words than scientific, as it seems to turn upon the nature of identity in relation to sound. It is enough to say that, whatever may be the merits of the controversy, it does not appear to us that the fact, if it is a fact, that sound itself is transmitted by the telephone establishes any material distinction between telephonic and telegraphic communication, as the transmission if it takes place, is performed by a wire acted on by electricity. We are of opinion, then, that, fully admitting all that has been or indeed can be said as to the novelty and value of the telephonic transmitter and receiver, the whole apparatus, transmitter, wire, and receiver taken together, form "a wire used for the purpose of telegraphic communication, with apparatus connected therewith, for the purpose of telegraphic communication"—that is, they are a telegraph within the definition of the Act of 1863, which is embodied by reference in the Act of 1869. The wire is a wire. The transmitting and receiving instruments are apparatus connected therewith for the purpose of conveying information by electricity; and this, as it seems to us, is telegraphic communication. Indeed, though for scientific purposes it may no doubt be necessary to distinguish between telegraphs and telephones, it seems to us that the word "telegraph," as defined in the Telegraph Acts, is (to use Professor Stokes' words) "wide enough to cover every instrument which may ever be invented which employs electricity transmitted by a wire as a means for conveying information." Indeed, looking to the extension of the definition inserted in the Act of 1869, the words "transmitted by a wire" might probably be left out of this definition. That this view does no violence to the common use of language is proved first, by the fact that in Mr. Edison's own specification the words "telegraph" and "telegraphic" are frequently used in reference to his invention, and that in "Webster's Dictionary," published in 1856, an electro-magnetic telegraph is defined under the head "telegraph," as "an instrument or apparatus for communicating words or language to a distance by the use of electricity," and under the head "electro-magnetic telegraph," as "an instrument or apparatus which, by means of iron wires conducting the electric fluid, conveys intelligence to any given distance with the velocity of lightning." Of course, no one supposes that the legislature intended to refer specifically to telephones many years before they were invented, but it is highly probable that they would, and it seems to us clear they eventually did, use language embracing future discoveries as to the use of electricity for the purpose of conveying intelligence. The great object of the Act of 1863 was to give special powers to telegraph companies to enable them to open streets, lay down wires, take land, suspend wires over highways, connect wires, erect posts on the roofs of houses, and do many other things of the same sort. The Act, in short, was intended to confer powers and to impose duties upon companies established for the purpose of communicating information by the action of electricity upon wires, and absurd consequences would follow if the nature and extent of those powers and duties were made dependent upon the means employed for the purpose of giving the information. Suppose a company found it essential

to erect posts along a highway, and suppose the body having control of the highway gave their consent, would the validity of the consent, and therefore the liability of the parties concerned to an indictment for obstructing the highway, notwithstanding such consent, be dependent on the question whether the messages were sent by an Edison's transmitter or by a Morse key? Or, again, suppose that the company favoured particular customers, and so enabled their friends to get greater advantages in trade or speculation over other persons, could they say, "We have a right to do so, notwithstanding section 41, because we use telephones and not telegraphs?" Or, still more, if one of their clerks negligently refused to send a message or improperly divulged its contents, would they, for the same reason, be deprived of the summary remedy given by section 45? Nearly every section of the Act would supply an additional illustration of the general conclusion that, but for the monopoly established in 1869, the Edison Telephone Company would be as anxious to be included in the Act of 1863 as they are at present to be excluded from it; but this is only an accident, which cannot affect the interpretation of the Act. Looking at the Acts from the point of view of the Crown we are led by a different road to the same conclusion. If a telephone is not a telegraph, then a telephonic communication is not a telegram, and if so any company may not only transmit such messages, but may perform all the incidental services of collection and delivery; and if this is so there is nothing to prevent all the railroad and other companies in possession of telegraphs from applying to them telephonic transmitters and receivers, and carrying on the business of telegraphy just as they did before 1869. The customer would write his message at the counter and the clerk would speak it through the telephone instead of using a less perfect instrument. It is difficult to suppose that the legislature intended to grant a monopoly so liable to be defeated, or that its language was meant to be so construed as to be limited to the then state of, perhaps, the most progressive of all sciences. In this connection we may dispose of one or two minor arguments by which it was attempted to show a distinction between telephonic messages and telegrams. It was said to be essential to a telegraphic message that it should be sent, not direct from party to party, but through the intervention of a messenger or clerk, and also that it should consist of signals having a conventional meaning, and not of actual words spoken. It seems to us impossible to regard these matters as essential to the process. A clerk may be regarded merely as an extra link in a chain of communication, and signals are only imperfect substitutes for words. It would be a strange thing to say that improvements by which a step in a given process can be dispensed with, and by which the process itself may be perfected, destroy the character of the process. To take such a view would be to affirm that imperfections in an instrument are essential parts of it, and that their removal destroys it. Apart from this a practical difficulty arises. There has been a constant progress in the subject of electric communication from its first invention to the present day. Some of the means employed require no code of signals, and some can be worked by any one who can read and write without any assistance from clerks. The A B C instrument worked by moving a hand successively to all the letters forming the message, and this moved a corresponding hand at the other end of the wire. Any two persons who could spell could use these instruments. Hughes' type-printing instrument prints the message in capital letters on a long narrow slip of paper. A telegraph called Cowper's writing telegraph has lately been invented, the nature of which is that a person holding a pen at one end of the wire can write or even draw with it, and that a facsimile is produced by a corresponding pen set in motion by the electric current at the other end of the wire. Two papers were produced before us written in what was said to be Chinese character and exactly resembling each other. The one was written by a Chinese lady and the other by the pen at the other end of the wire.* Now, either these instruments are telegraphs, and the messages sent by them telegrams within the Act, or they are not. If Cowper's writing telegraph is within the Act it is difficult to say why a telephone is not. They equally dispense with clerks or messengers. If the sound is in any sense transmitted in the one case, the motions of the hand are in the same sense transmitted in the other. The one reproduces actual written words quite as accurately as the other reproduces words spoken; and if the one can properly be described as a complicated speaking trumpet, the other can with equal propriety be described as an elongated pen. If, on the other hand, Cowper's writing telegraph is not within the Act, it is equally difficult to say why Hughes' type-printer is within it. It requires no messenger or servant at least at the receiving end, and it employs no special code of signals. It is, however, impossible to doubt that it is included, for it was in common use long before the Act of 1869, having been invented in 1854, and having procured the Grand Prix for its inventor at the Paris Exhibition of 1867.† The result seems to be that it is impossible to draw the line between these instruments, and that all or none must be regarded as coming within the definition of the term "telegraph" so often referred to. For all these reasons we hold that a telephone is a telegraph within the meaning of the Acts of 1869 and 1863. The second point made by the defendant Company was that, whether the telephone was a telegraph or not, the conversations held through it were not "messages or communications" sent by a telegraph within the meaning of the Act. This contention was founded partly on the argument that the directness of communication between the parties to the conversation rendered the word "message" inappropriate, and partly on the Telegraph Acts of 1863 and 1868, which, it was said, use the word "message" in the sense of a substance with a message written upon it, and on the Telegraph Act of 1869, which, it was said, uses the word "communication" in a peculiar sense. As to the word "message," it is, no doubt, true that in several sections it is so used; but in others it seems to us to be used in the sense of the purport or tenour of the message. It is, for instance, an offence to delay to "transmit or deliver" a message. "Transmit" obviously applies to the words and not to the paper; "deliver" to the paper and not to the words; and so in other cases. The same remark applies to the Act of 1868, in which the word "message" is frequently used, and which was commented upon by Mr. Webster minutely. All the difficulties raised or attempted to be raised appear to us to be capable of solution by the single principle already stated. The word "communication" in the definition of "telegram" given in the Act of 1869 was said to have found its way there from sec. 16 of the Act of 1868, which authorises the Postmaster-General to make contracts with the proprietors of newspapers and others for the transmission or delivery of "telegraphic communications" to them at certain times and on certain terms, and it was rather suggested than expressly argued that such communications only would

* This was done by Arlincourt's telegraph.

† Hughes' telegraph is referred to in the Act of 1868, sec. 8.

be telegrams within the meaning of the definition of the Act of 1869. We do not agree with this view. The use of the word "communication" instead of message in sec. 16 of the Act of 1868 certainly favours the opinion that there might be communications which would not be properly described as messages, but there is nothing in the definition of a telegram in the Act of 1869 which suggests that the word "communication" which it contains is to be restricted to the communications mentioned in sec. 16 of the Act of 1868. It is very possible that the use of the word in the one section may have suggested its use in the other, but there is nothing to narrow its sense in the last-mentioned section. For these reasons we hold that a conversation held through a telephone is either a message or, at all events, a communication transmitted by a telegraph, which is the definition of a telegram. A small question was raised on the word "transmitted." When one person speaks to another it was said he "makes," but does not "transmit," a communication. The answer is that when he speaks through a wire some miles long he sends what he says through the wire, or transmits it. As the defendants contended that the very voice itself was so sent, this seems specially clear as against them. It was further argued that, admitting the conversations in question to be telegrams, they were still not within the Act of 1869, because the preamble of that Act recites that "similar powers to those conferred upon the Postmaster-General with respect to the exclusive privilege of conveying letters should be enacted with reference to the transmission of telegraphic messages." This, it is said, confines the exclusive privilege as to telegrams within the limits within which the exclusive privilege as to letters is confined, and subjects it to the same tacit exceptions. But the exclusive privilege of the Postmaster-General as to letters is "the exclusive privilege of conveying from one place to another all letters" (6 and 7 Wm. IV., chap 33, sec. 2) subject to certain exceptions. No express exception applies to the case of a man who carries his own letter with his own hand to the person to whom it is addressed. Yet this exception has always been regarded as tacitly implied in the Act, and no one ever supposed that a man who came within it violated the Postmaster-General's exclusive privilege. It was argued that, in like manner, if two friends communicated with each other directly by a telegraph of which they were joint owners, they would be outside of the sphere of the Act of 1869. To this argument there are, in our opinion, several conclusive answers. In the first place, we do not think that the recital in the preamble of the Act of 1869 ought to have the effect ascribed to it. Each Act must be construed independently. The practical inconvenience of construing the Post Office Act literally would be so very great that it can never have been seriously proposed so to construe it. It is enough to say that such a construction would have involved the consequence that when a letter was written it must be left on the table at which it was written till the postman called and took it away, visiting every room in every house for that purpose. Such a consequence is an absurdity, but there is no absurdity in supposing that the legislature meant to prohibit private electric telegraphs. The extent to which they were intended to be prohibited will appear from the exceptions to be considered immediately. In the next place, there is no real analogy between a man carrying his own letter to his correspondent's house and two men telegraphing to each other. In the one case the act done can by no conceivable means injure the revenue. In the other case, an apparatus must be employed which may readily be made to injure the revenue. The object of the Post Office Act is to give to the Postmaster-General an exclusive right to earn all that can be earned by carrying letters, but a man cannot pay himself for carrying his own letter. If he gets a friend to carry it for him he might pay, and this case is accordingly provided for by an express exception. In the third place, the customers of the Telephone Company do not in fact communicate directly with each other. They are put in communication by a servant of the Company, and their messages travel in all cases over at least one wire, and in many cases over three separate wires which are the property of the Company. On all these grounds we hold that the conversations held through the telephone are infringements of the Postmaster-General's exclusive privilege unless they can be shown to be within the exceptions to that privilege. We now pass to two exceptions. Those which are said to apply are the first and second in section 5 of the Act of 1869. The first is in these words—"Telegrams in respect of the transmission of which no charge is made, transmitted by a telegraph maintained or used solely for private use, and relating to the business or private affairs of the owner thereof." The second is—"Telegrams transmitted by a telegraph maintained for the private use of a corporation, company, or person, and in respect of which, or of the collection, receipt, and transmission, or delivery of which no money or valuable consideration shall be or promised to be made or given." These exceptions resemble each other so closely that it is not easy to put a case of a telegram which would fall within the first exception and which would not fall within the second. Every "telegraph maintained or used solely for private use" must be a "telegraph maintained for the private use of a company, corporation or person." A "telegram for which no charge is made" does not differ materially from a "telegram in respect of which, or of the collection, receipt, and transmission of which no money or valuable consideration shall be or promised" (the words "shall be" seem to be wanted before "promised") "to be made or given." And a message "relating to the business or private affairs of the owner" of the telegraph by which it is sent is a telegram. Thus the second exception seems to contain everything which can fall within the first and nothing more, except possibly telegrams not charged for transmitted by a telegraph used solely for private use and relating to the business of the owner of the telegraph, such telegraph not being maintained by the owner. But no case occurs to us in which a man is likely to own a telegraph and use it exclusively for his own business and yet not to maintain it. It was suggested that one of these clauses was added by way of amendment as the Bill passed through Parliament. It may be so, but it is difficult to conjecture what the object of the amendment can have been. Whatever may have been the history of the two exceptions the meaning of the first of them is in one point obscure. It authorises individuals to keep telegraphs for their own use and to send messages by them relating to their own affairs so long as no charge is made for the messages. This condition is to us unintelligible. How could a man make a charge to himself for sending a message on his own telegraph about his own affairs? It seems as if the exception had been originally intended to provide for two classes of telegrams, sent by telegraphs maintained or used solely for private use—namely, first, telegrams relating to the private affairs of the owner; and, secondly, telegrams relating to other people's affairs, sent as an exceptional favour and not charged for; but this is certainly not said. The second exception provides not only for most of the cases provided for by the first exception, but also for the case which seems to have been, for some reason, omitted from the

first exception. The telegrams to which the second exception refers may relate to any subject so long as they are not charged for and so long as the telegraph by which they are sent is maintained for the private use of any corporation, company, or person. Upon the whole the effect of the two exceptions seems to us to be that if a person, company, or corporation has a telegraph maintained *bonâ fide* for his or its own use—if, for instance, a banker has a telegraph to communicate between his office in the city and another office in a distant part of London, or if under the Act of 1868 (sec. 9, 8) a railway has made arrangements with a coal master upon the company's system for a private telegraph between his coal pit and a station, they may not only send telegrams on their own affairs, but may also, under special circumstances, and if no charge is made, send messages on the affairs of others. This view of the exceptions shows how wide the exclusive privilege granted to the Postmaster-General was intended to be. But for them it would be unlawful for the owner of works spread over a great space of ground to have a telegraph to communicate between the different parts of the establishment, or for a man of business with two offices in different parts of London to have a telegraph between them. This supports what we have already said as to the difference between the exclusive privilege of the Postmaster-General in relation to telegrams and in relation to letters. The privilege relating to telegrams seems to us to be the wider of the two. It was argued by the defendants that they were within the first exception, because in it the word "owner" ought to be read as including "owners," the effect of which was said to be that two persons might contribute to keep up a telegraph, and use it for communicating with each other on affairs interesting to either, that each of them might again communicate with others, and that thus the country might in theory be covered with a network of telegraphic wires, each connecting two persons only. It was further suggested that if this were lawful, it would be lawful in order to avoid circuity and complication to consolidate the individual wires into a small number owned by a large number of subscribers, and this it was said was practically what was done by the defendant Company. This ingenious argument appears to us to be unfounded both in law and in fact. The exceptions seem to us to apply exclusively to telegraphs kept either by a single owner or under one express provision of the Telegraph Acts, like the one already referred to; but, quite apart from this, it is obvious that the telegraphs of the defendant Company are neither owned nor maintained by the subscribers, nor are they used solely by the owners. The switch board and the trunk wires are the property of the defendant Company, and they are essential to the system of communication adopted. Moreover, a charge in the shape of rent is made for the transmission of messages, and from this the Company derives a profit. Each of these circumstances takes the case out of the exceptions, or rather prevents them from applying to it. Lastly, it was asked by the defendants when and by whom the offence, if any, of the defendant Company, was committed. To this we think the answer is—that if several persons combine to do an illegal act each is guilty of the whole of it, so that when A sends a telegram to B by means provided by the Company for that purpose and under the provisions of a contract by which it is carried out, A, B, and the Company are all guilty of an offence under section 6 of the Act of 1869—namely, the offence of transmitting a telegram. Apart from this, we think that when the Company's servant puts A in telephonic communication with B, the Company aids and is concerned in transmitting a telegram, which, again, is an offence under the same section. The result is, that we give judgment for the Crown, with costs There will, accordingly, be declarations in the terms of paragraphs 1 and 2 of the prayer, an injunction in the terms of paragraph 3, and an order that an account be taken as in paragraph 4.

MR. WEBSTER, on the part of the defendants, intimated that there would be an immediate appeal, and the injunction was ordered to stand over until its determination.

TELEGRAPHIC APPARATUS IN USE IN THE BRITISH POSTAL TELEGRAPH DEPARTMENT.

XXIV.

THE WHEATSTONE AUTOMATIC SYSTEM.

(Continued.)

FIG. 90 shows a general view of the controlling mechanism of the transmitter, whose action was explained by figs. 87, 88, and 89, in the last article. The star wheel which draws the punched slip from right to left is seen at the top of the steel rods, S, M, and lies between them. A small roller, R, with slots cut in its circumference which receive the teeth of the star-wheel, is pressed down on the paper slip by means of a spring, and keeps its movements steady. Fig. 91 shows the arrangement in detail. The star-wheel, which is turned by the same train of clockwork which actuates the rocking lever, Y, is so geared that the up and down movements of the rods, S, M, take place exactly when the perforations in the paper slip come opposite the ends of the rods.

The exact positions of S and M are regulated by the screws, P_1, P_2, and in order that the apparatus may work properly, each of the rods should be so adjusted that it commences to enter a perforation in the slip at the moment when the left-hand edge of the perforation is over the left-hand edge of the end of the rod. If the screws, P_1, P_2, are screwed out too far, the rods, instead of entering and passing through the perforations, will catch against the edges and be stopped; this will also be the case if the screws are too far back. The springs, s_1, and s_2, keep the rods, S, M, firmly against the screws, P_1, P_2, except when the latter are descending, the moving slip then pulls them forward until they have become lowered sufficiently to be withdrawn completely from the holes, when they spring back against P_1, P_2, under the influence of s_1, s_2.

The holes through which S and M, and the star-wheel, pass will be seen in Fig. 92.

In order to insure rapidity of action, it is essential that the springs, s_3 and s_4, be strong, otherwise the levers, A and B, will not be drawn up against the pins, p_1, p_2, on the rocking beam, with sufficient rapidity.

The spring carrying the jockey-wheel, E, should not be too strongly screwed down against the top tail-piece of the disc, D, otherwise the disc will tend to stick to the one side or the other. The tension required is that which is just sufficient to keep the disc, D, firmly over to one side or the other.

The action of the rocking-beam, Y, can be understood from fig. 93, where it will be seen the left-hand end of Y has a small rod hinged to it which is

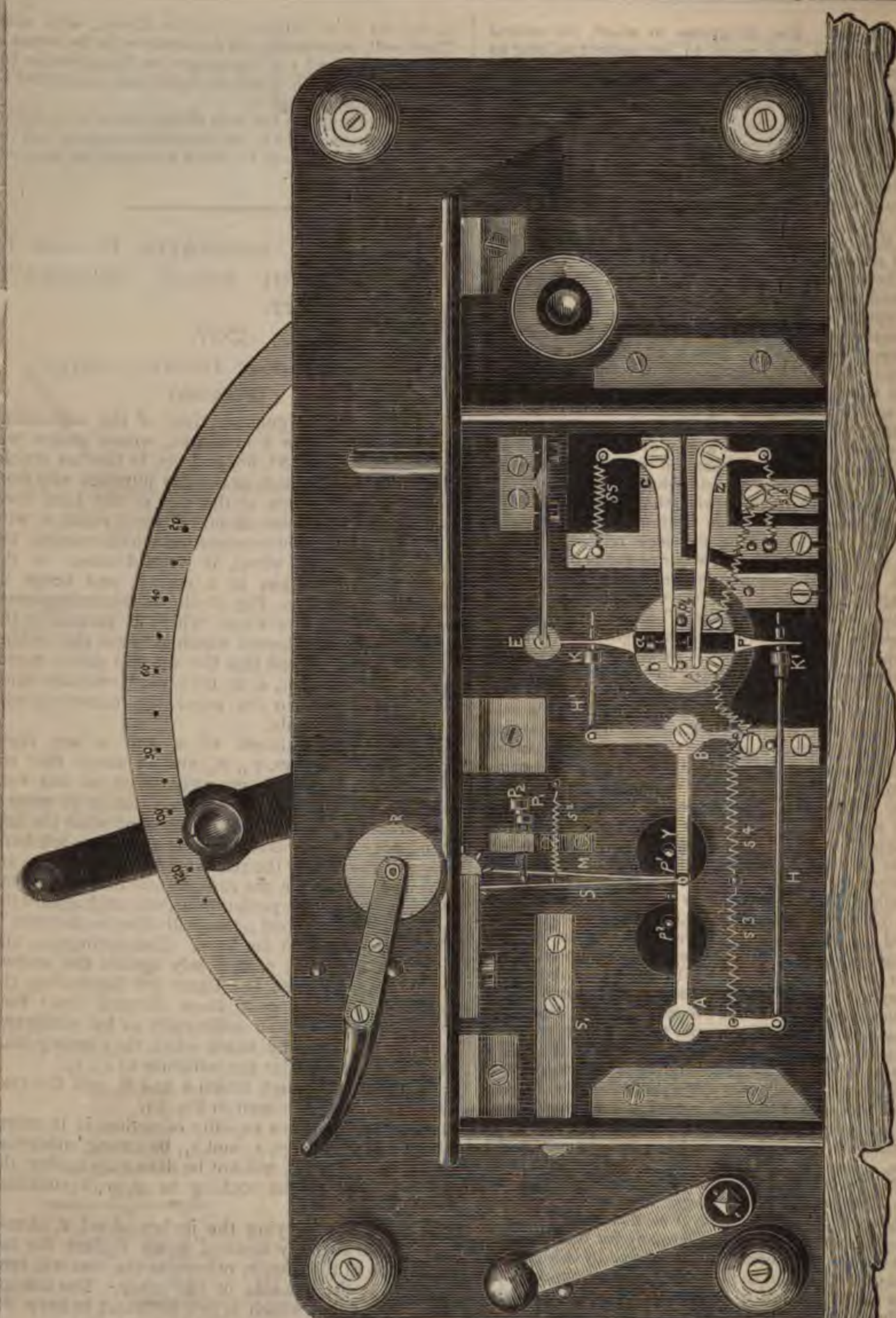


FIG. 90.

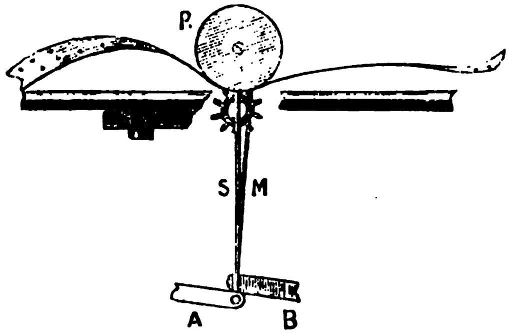


FIG. 91.

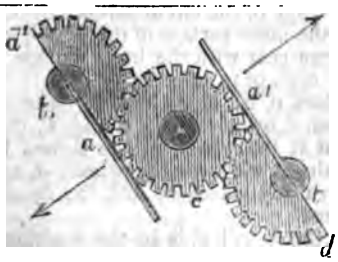


FIG. 95.

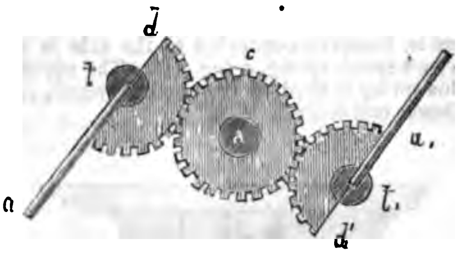


FIG. 96.

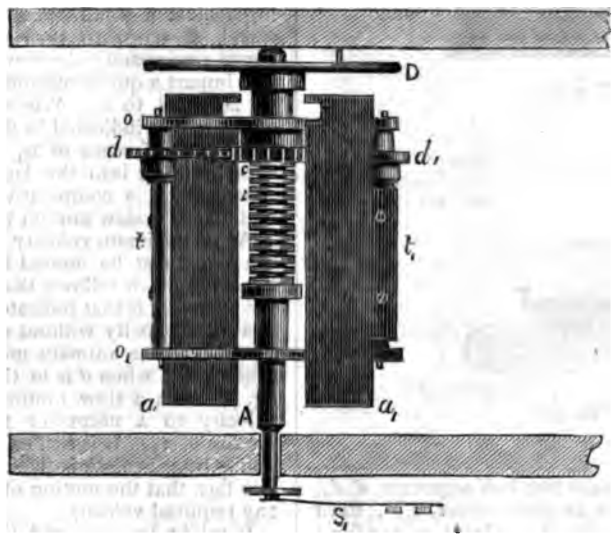


FIG. 94.

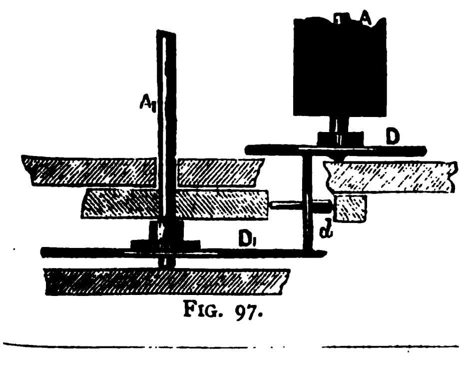


FIG. 97.

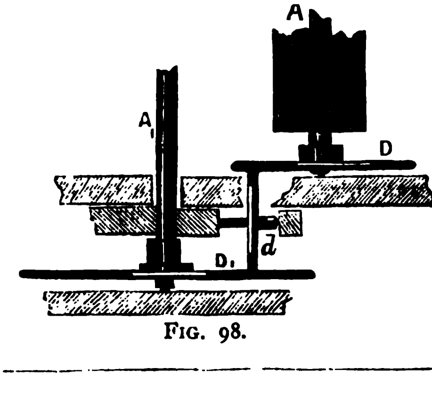


FIG. 98.

worked by a crank-pin set at the end of one of the axles in the clockwork train. The connections on to the pins, p_1, p_2, are made by means of long spirals of wire at the back of the beam.

An important part of the mechanism of the apparatus is the "fly" and its regulator, by means of which the speed at which the clockwork train runs can be regulated.

The fly is specially constructed so that the clockwork can start off at as nearly as possible its normal speed. If the apparatus took time to get up speed, several signals at the commencement of a message might be lost.

The construction of the fly can be seen from figs. 94, 95, and 96. Referring to the two latter figs., *c* is a toothed wheel which turns loose on an axle, A, which is driven by the clockwork; this toothed wheel is, however, connected to the axle in question by a spiral spring, *z* (fig. 94). The upper end of this spring is fixed to the toothed wheel, *c*, and the lower end to the axle, A.

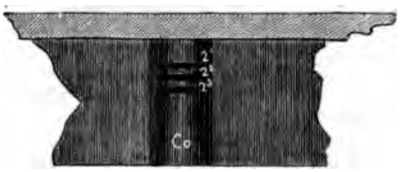


FIG. 92.

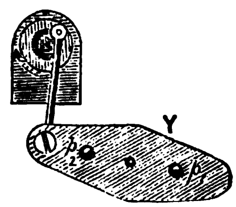


FIG. 93.

The wheel, *c*, gears into two half segments, *d*, d_1, whose axles, *t*, t_1, turn in cross-pieces, *o*, o_1, fixed rigidly to the axle, A. To the axles, *t*, t_1, are fixed the fly-wings, *a*, a_1. The action of the spiral spring connected to the wheel, *c*, and its axle, is to turn the segments, *d*, d_1, and their fly-wings to the position indicated in fig. 95; when the whole arrangement is rotated about the axle, A, in the reverse direction in which the hands of a watch turn, then the edges of the wings only practically beat against the air; but the rapid rotation, by centrifugal force, causes the wings to turn round in the direction of the arrows (fig. 95); their inside surfaces then commence to beat against the air, and this action at once throws them still further open to the position indicated by fig. 96, or even further open still. The full surface of the wings thus being exposed to the surface of the air, the speed of rotation of the clockwork is kept in check.

It will thus be seen that the check-action of the fly is very small at first, so that the clockwork can start off quickly, but as soon as speed is attained the fly-wings open, and a full check is put on.

The regulator, by means of which any required speed can be obtained, acts in the following manner:—

On the fly-axle, A (figs. 94, 97, 98), is fixed a solid steel wheel, D, with a brightly polished outer surface. To the axle, A_1, which is directly in gear with the clockwork train, is also fixed a bright steel wheel or disc, D_1, and between D and D_1 a third loose steel wheel, *d*, with a smooth edge. The axle of *d* is carried on a small frame, which can be shifted backwards or forwards by means of the handle seen at the upper part of fig. 90; thus *d* can be made to gear near the edge of the circumference of the disc, D_1, and near the inner surface of the wheel, D, as in fig. 97, or it can gear with the inner surface of D_1, and the outer edge of D, as in fig. 98.

Now the discs, D, D_1, being kept in close contact with the wheel, *d*, by means of a spring, S_1 (fig. 94), it follows that if the wheel, D_1, be turned by the clockwork train, it will turn the wheel, *d*, and the latter will turn the wheel, D, and the fly-axle on which it is fixed.

Now when the wheel, *d*, is in the position indicated in fig. 97, the wheel, D_1, tends to turn it rapidly, since we have a large circumference gearing against a small circumference. Similarly, the wheel, *d*, tends to turn the wheel, D, quickly; hence a comparatively slow motion of the axle, A_1, will impart a quick motion to the axle, A, and the fly attached to it. When, however, the state of affairs is that indicated in fig. 98, then we have the small circumference of D_1 gearing into *d*, and the latter gearing into the large circumference of D, consequently a comparatively quick motion of A_1 will impart a slow motion to A.

As the ultimate velocity at which the clockwork can turn must be limited by the rate at which the fly can turn, it follows that when the position of the wheel, *d*, is that indicated in fig. 98, A_1 can turn at a high velocity without moving A at such a rate as to check the ultimate motion of A_1; and, on the other hand, when *d* is in the position indicated in fig. 97, then a slow motion of A_1 will impart the velocity to A necessary to check the ultimate motion of A_1. It is evident, also, that if *d* be set at points intermediate between those indicated in the two figs. that the motion of A_1 can be regulated to any required velocity.

It might be imagined that the wheel, *d*, would slip instead of turning with the wheels, D, D_1, but the "bite" between unlubricated polished steel surfaces is actually very considerable, and but little slip takes place.

ERRATA.—Article XXIII., page 431. Left-hand column, 9th line from bottom, read "fig. 89" for "fig. 87"; 8th line from bottom read "zinc" for "copper"; 7th line from bottom read "copper" for "zinc"; 5th line from bottom read "fig. 87" for "fig. 89;" bottom line read "left-hand" for "right-hand." Right-hand column, 5th line from top, read "fig. 87" for "fig. 89"; 7th line from top read "fig. 89" for "fig. 87"; 8th line from top read "zinc" for "copper"; 9th line from top read "copper" for "zinc."

Notes.

THE TELEPHONE.—The telephone case is for the present finished, and now the postal authorities are preparing to supply the public with telephonic intercommunication. H.M. Postmaster-General has ordered of the Gower-Bell Telephone Company 20,000 telephones, and the Postal Telegraph Department has already received many hundred applications for the instalment of that instrument. Any attempt on the part of the United Telephone Company to pose as injured inventors is absurd, for the original inventors are but slightly interested, in a pecuniary sense, in it; Prof. Graham Bell perhaps to the extent of one share, and we believe Mr. Edison not at all. Besides, the Department has made very fair and liberal terms with the Gower Company, in the profits of which the United Company is largely interested, so that it seems probable that the latter may make a much larger profit now the Government have taken up the telephone than it would have done under its own erratic management, and certainly more than it has done in the past. We learn that circulars and recriminations are freely passing in the camp of the United Company, and that a meeting is called for the 13th instant. Among the advantages to be named consequent on the Post Office letting out telephones is, first, the lower price at which the rental is placed (£15 as compared with £20); second, the connection being made with the general telegraph system; and, third, the fact that probably more underground wires, instead of the unsightly and dangerous overhead wires, will be used than would have been the case under the older system.

WE understand that a revised and enlarged edition of Mr. H. R. Kempe's "Handbook of Electrical Testing" is now in the press and will shortly be published by Messrs. E. & F. N. Spon.

TWO NEW ATLANTIC CABLES PROPOSED.—It is probable that a company, to be called the American Union Cable Company, will soon be organised for the purpose of laying two Atlantic cables, which will be operated in connection with the American Union Telegraph Company. Estimates for the construction of the two new cables have been received in this city. The cost of construction is understood to be less than £1,500,000, and it is probable that Siemens & Co. will be given the contract for the work. It is proposed, if the cables are laid, to land them on the American side at Whitehead Bay Harbour, in Nova Scotia, just east of Torbay. The English end will be near Penzance. So says the New York *Operator*.

The New York *World* gives the following correspondence on the same subject:—

"London, Dec. 11.

"Have just returned after eight weeks' absence in the Mediterranean, where I have been endeavouring to give an international character to the whole of our system of submarine telegraphs, and with considerable success, an idea which I am anxious should be participated in by the great American telegraph system. The French cable, properly worked, should meet all the requirements of your own company for the moment. To spend more money in laying new cables at present would be equally disastrous to the new as to the present systems. I am hopeful that the French cable will be put into a thoroughly efficient working state so soon as the agreement with us is ratified. I shall do all in my power consistent with any existing obligations in order to bring about such an arrangement as will satisfy the requirements of your traffic. My visit to America is only delayed. It is my full intention to come out in the spring. The French Company's meeting for confirmation of the agreement is to be held Jan. 12 next.

"JOHN PENDER, London.

"Jay Gould, New York."

"New York, Dec. 12, 1880.

"Your despatch received. As an evidence of my entire friendliness to your interests, I carefully communicated through Mr. Ward to you some weeks since the concessions our large interests on this side required from the existing cables, and at the same time I informed him that unless these were granted we should lay our own cables. Having received unfavourable responses, I accordingly opened subscriptions for two new cables. The entire amount is subscribed, and we shall proceed to lay them. At the same time I cordially reciprocate your sentiments as to international telegraphy, and will do my share towards its vigorous and rapid development by laying independent cables.

"JAY GOULD, New York.

"John Pender, London."

The following particulars are also taken from an American newspaper:—

"Subscriptions for the construction of two new cables have been opened by the Central Construction Company. The fund which is to be raised is 6,000,000 dols., of which one-half will be reserved for the subscribers of the Central Construction Company of record on September 15th last. The calls on the subscribers will be 10 per cent. of their subscription at a time. For every 1,000 dols. paid up the subscribers will receive ten shares of stock of the value of 100 dols. each and a 1,000 dols. 6 per cent. mortgage bond. The privilege to subscribe will expire on December 31st, 1880. The contractors for the new cables will be Messrs. Siemens and Co., of England. The American end of the cables will be at Whitehead Bay Harbour, just east of Torbay, in Nova Scotia, the landing on the English side to be made near Penzance."

THE Board of the West Coast of America Telegraph Company, Limited, inform us that in consequence of the continuance of the war between Chili and Peru, they are obliged to defer payment of the coupons on the debentures of the company, due on the 31st of December

THE s.s. *Scotia*, which left London on the 18th ultimo, to raise and repair the Brest Cable (1869) broken on the 12th November last, has put into Plymouth for orders. The Telegraph Construction and Maintenance Company's engineer reports, that after picking up the eastern end of the cable at 220 miles from Brest, the weather became too boisterous to justify him in the expectation that further operations could be continued during the winter with any reasonable prospect of success. Under these circumstances the directors have decided to postpone the repair until next spring.

WE are requested to state that Joel's improved incandescent lamps, recently described in these columns, can be obtained at the Electric Light Agency's offices, 52, Queen Victoria Street, where they can be seen at work.

THE Edinburgh Rosebank Iron Works, which have been for some time experimentally lighted by a Crompton lamp, are now about to be permanently lighted by three of those lamps.

THE first public telephone line in Germany was opened a few days ago by the Berlin Telegraph Office.

PHILADELPHIA newspapers report that the American Union Telegraph Company are about to try in that city the experiment of putting their wires underground. The plan works well enough in European cities, and there would seem to be no reason why it should not succeed here, save the indisposition of the companies to bear the first cost of making the change. For some months the Western Union Telegraph Company has had the matter under consideration, but will probably wait until pressed by a rival company before it undertakes the more serious task of taking down its forest of poles and sinking the wires which contribute so much to the prevailing ugliness of our streets. Sooner or later the poles and wires must come down, and it is altogether probable that the change will be beneficial to the companies in the long run, owing to the smaller cost of maintaining a subterranean system. It will certainly be an advantage to the community.—*Scientific American.*

AT a recent meeting of the Mersey Docks and Harbour Board it was resolved to adopt the electric light at a portion of the new dock system at the north end of the city, at an estimated cost of £2,000. This is to be an experiment, and upon the result will depend the extension of the light over the docks generally.

THE TELEPHONE.—Mr. Rolls, of the South-Western Railway Telegraphs, has lately been carrying out some experiments with the Gower-Bell loud-speaking telephone which have proved remarkably successful. In the first place the instrument was tried over sections of varying lengths as a means of verbal communication between signal cabins, a noteworthy point in the experiments being that the block wire itself was the only connection between the distant points, Mr. Rolls placing the telephones in multiple circuit with the block instruments at each end, between line and earth, in such a manner as in no wise to affect the block working; in fact, while listening at the telephone a train passing the distant cabin could be heard simultaneously with the receipt of the ordinary signals upon the block instrument indicating the train's departure. The movement of the levers placing signals on behind the train five miles away could also be distinctly heard. Conversation was carried on with the utmost ease by inexperienced persons, and all sounds were remarkably clear, although several through postal wires worked by powerful currents ran on the same set of poles. This form of telephone having proved so successful, it was subsequently tried as a long circuit speaking instrument between Yeovil and Exeter, a distance of forty-nine miles, upon the same set of poles as before; and despite the usual effects of induction, the voice was as remarkably predominant and as clearly and distinctly heard as in the previous experiment over a short section. Further trials indicated that the distances mentioned might be at least doubled.

MR. CROMPTON has contracted to illuminate with electric light the Bricklayer's Arms goods station of the South-Eastern Railway Company. He is also entrusted with the lighting of the Glasgow Post Office and the goods station of the North British Railway. The winter contract for the Alexandra Palace is likewise placed in his hands.

IT seems probable that in another two or three months nearly all the principal railway stations in London and many of those in the country will be electrically lighted. Indeed so rapidly does demand now follow on demand for the necessary apparatus that all the existing manufacturers must ere long be overpressed with orders.

A METHOD FOR PRODUCING THE LIGHT-PHENOMENON OF GEISSLERS' TUBES.—L. Weber.—A U-tube whose limbs are about 770 millimetres in length is filled with mercury, inverted and placed with its limbs in two capsules filled with mercury and connected with the ends of an induction-coil.—*Wiedemann's Beiblätter.*

ON THE PERMANENT MAGNETISM OF HARD STEEL AND THE INFLUENCE OF CONCUSSION.—H. Kulp.—Hard pieces of steel were permanently magnetised and the decrease of the permanent magnetism was observed on their being submitted to concussion. The same process was repeated three times. The magnetism was never inverted as is the case with soft iron. The decrease is the smaller the greater the original magnetism. Soft iron behaves in a manner exactly opposite.

ON AN AUTOMATIC COMMUTATOR FOR ELECTRIC LIGHTS.—A. A. de Pina Vidal.—The author has devised an appliance which exchanges the Jablochkoff candles when burnt down.—*Jornal de Sciencas Math. Phys. e Nat.*

EXPERIMENTAL INVESTIGATIONS OR CHANGES IN THE ABSOLUTE TENACITY OF IRON WIRES PRODUCED BY THE ELECTRIC CURRENT.—G. Hoffmann.—An increase of tenacity was observed in iron wires after being traversed by the current. Wire which in its original state was able to support 2,363 grm. after a three hours' passage of the current supported 2,391, showing an increase of 28 grm. With the prolongation of the action of the current the increase of tenacity became greater till it attained a maximum which was reached earlier in some wires and later in others. Thus wires of 0·19 millimetre in thickness after a three hours' passage of the current showed an increase of tenacity = 28 grms., after 12 hours', 44, and after 24 hours' 50; another wire of 0·31 millimetres in diameter after three hours showed a gain of 12 grms., after 12 hours, 23 grms., and after 24 hours no further increase. With feeble currents the increase of tenacity in equal times is almost proportional to the strength of the current, but for stronger currents this law is no longer available owing to the heating of the wires. Thus in the wire of 0·19 millimetre diameter a 12 hours' passage of a current causing a deviation of 4° gave an increase of strength = 20 grms., one of 6° = 29 grms., and one of 9° = 44 grms. During the actual passage of the current the increase was greater. The author considers that the increase of cohesion is favoured by the heat evolved by the current, but that the current itself plays an essential part.—*Wiedemann's Beiblätter.*

HIPP'S COMPASS FOR THE MEASUREMENT OF STRONG CURRENTS.—E. Hagenbach. Hipp employs a simple compass with a needle playing upon a point. Beneath the latter a strip of copper, 20 millimetres in breadth and 1 millimetre in thickness, is made to pass and return, the two superimposed halves being isolated from each other by a piece of cardboard. On the passage of currents the deviations of the needle correspond to the differences in their action.—*Zeitschrift für Angewandte Electricität* 2. P. 64.

MANAGEMENT OF BUNSEN ELEMENTS.—L. Beilstein and F. Jawein. In order to prevent the oxidation of the conductive wires, binding-screws, &c., they are rubbed over with oleonaphtha prepared from Caucasian petroleum. The resistance is not perceptibly increased. Other mineral oils would act in a similar manner.

THERMO-CHEMICAL RESEARCHES.—Julius Thomson. The author gives in Kolbe's *Journal für Praktische*

Chemie the values which he has calculated for the energy of different galvanic combinations. Zinc, sulphuric acid, sulphate of copper, and copper being =1·00; zinc, sulphuric acid, monohydrated nitric acid, and carbon =1·92; and zinc, sulphuric acid, chromic acid, and sulphated carbon =1·99.

ON THE THEORY OF THE VOLTAIC CIRCUIT.—G. Cantoni. The author compares circuits with a motor, driven by water or steam, in which motion is occasioned by a difference of pressure, which is continually renewed, and consequently presupposes a permanent circulation of the water or the steam. As in the case of steam, water is also raised by the energy of heat (the sun's rays). In thermo-electric combinations the required difference of pressure depends on the difference of the electric potential at the point of contact of the heterogeneous elements, to which a source of heat is approached. The heat at the point of contact is converted into electricity, which moves in the circuit with an energy proportional to such difference, so that the intensity of the current corresponds to the quantity of heat converted into electricity in a unit of time.

In a friction machine in the same manner the potential difference at the point of contact and the quantity of heat expended in maintaining the speed of the bodies rubbed together and separated from each other must come into play.

In the galvanic element the energy (heat), which is partially transformed into electricity, depends on the chemical processes which in the first place effect merely a rise of temperature. By the potential difference at the points of contact it acquires, according to Cantoni, a direction. A simple potential difference between two bodies can only give the first impulse in a given direction between the elements of a closed electric circuit. It could not produce a current capable of continually overcoming outward and constantly renewed resistance if the impulse were not renewed by a permanent source of heat in consequence of the internal chemical processes. As in the thermo-circuit, only that part of the heat which circulates in the element is utilised in the current which is thus called forth by chemical action electrically directed.—*Wiedemann's Beiblätter.*

AN interesting relic of the early days of telegraphy has been discovered at Morristown, N. J. It is the first instrument by which messages were received and sent by aid of the electric current, and was one of two taken from Morristown by Morse and Vail—Morse using one at Washington, and Vail the other at Baltimore. The first message sent was the now well-known "What has God wrought?" which Morse transmitted to Vail; but the first public message was the news of the nomination of Polk to the presidency by the Baltimore convention of 1844, sent by Vail to Morse. These instruments were in constant use for six years when Mr. Vail, returning to Morristown, brought his with him, and where it has still remained in the possession of his family. Mr. Vail dying soon after, his instrument was specially left by a clause in his will to his eldest son as an heirloom, while parts of instruments made during the experimental trials were left to Professor Morse, with a request that he would give them at some future day to the New Jersey Historical Society. The old instrument works as well as when first made. Its dimensions are 16 inches in length, 7 inches in height, 6 inches wide, with two magnets of 3 inches diameter. The paper used was 2½ inches in width, three pens being proposed to be used. The weight of the instrument is twenty pounds.—*From "Telegraphic Tales and Telegraphic History."*

MR. SWAN has been elected President of the Newcastle-on-Tyne Chemical Society. At his introduction Mr. Swan delivered an address, in which he dealt with the use of electricity as an agent for fusing the highly refractory metals.

M. GASCO has applied electricity as a motive-power to a portion of the Turin-Modena Railway, a length of 200 metres. The dynamo machine is worked by hydraulic power.

THE Government of India have requested the Indian Chamber of Commerce to furnish their opinions as to the inauguration of the telephone system in India. This request is based on the application of the Bell Telephone Company for permission to work the Edison and Bell system in India.

M. BLONDLOT finds that when a piece of annealed selenium is connected to one pole of a Lippmann capillary electrometer, by means of a platinum wire, and a plate of platinum is similarly connected to the other pole, a comparatively powerful electric current is developed by rubbing the selenium against the platinum plate.

DR. UELSMANN finds that silicum iron may be used as the negative element in a nitric acid battery, as this substance is passive in the acid.

THE sorting office and instrument gallery of the Glasgow Post Office have recently been lighted by the Crompton electric light. The rooms are peculiarly adapted for electric lighting. Two lamps of 4,000 candle-power each and worked by two dynamo machines were used. Every part of the instrument room was well lit, and the temperature, which with gas at 7 P.M. was 66½° F., fell to 62° F. at 8.40 P.M., the electric light being started at 7.25 P.M. In the sorting gallery the temperature fell from 66° to 64°. The verdict of the employées was unanimously in favour of the new light, and it is stated that several sorters dispensed with their spectacles whilst engaged in their duties, and that they felt much fresher and free from any feeling of headache than usual.

THE PARIS EXHIBITION OF ELECTRICITY.—It is now finally settled that this exhibition will be held in Paris, in the palace of the Champs Elysées, opening on the 1st August, 1881, and closing on the 15th November following. Applications for space will have to be made not later than the 31st March next to the Commissionare General at Paris. The exhibition will be divided into the following groups:—Apparatus employed for the production and transmission of electricity; natural and artificial magnets; physical electrical apparatus; exhibits of the applications of electricity to industrial purposes, such as the transmission of signals and sound, the production of heat and light; its employment in the service of lighthouses, in mines, railways, and navigation; its adaptation to military purposes, fine art, galvanoplastic and chemical arts, the transmission of force, mechanical arts, horology, medicine and surgery, astronomy, meteorology and geodesy, agriculture, registering apparatus, domestic uses, lightning conductors, and historical models. The exhibits will also include books. Exhibitors will not be charged for space. Diplomas and medals will be awarded to exhibitors upon the reports of juries organised at the time of the exhibition. It is probable that the Prince of Wales will be president of the congress of electricians and of the exhibition. The exhibition will be opened from half-past eight to six. A general catalogue of the exhibition will be drawn up.

Review.

Diagrams of Magnetism and Electricity. Sheet IV.: The Electric Telegraph. By WILLIAM LEES, M.A., Lecturer on Natural Philosophy, Edinburgh. W. & A. K. Johnston, Edinburgh and London.

No effort has been spared to make this sheet as complete as any of the previous publications of this eminent firm. We think, however, that some of the pieces of apparatus illustrated might have been of more modern pattern. Notwithstanding the assertion in the handbook to the diagrams that "the single needle instrument is extensively used by our railway companies," we doubt very much if there be one of the forms illustrated now in actual use in the United Kingdom. A similar remark applies to the apparatus for the "detection of faults," which has two galvanometers, one in the line and the other in the resistance arm. A perusal of the handbook to the diagrams leaves the impression on the mind that the writer is unacquainted with the practice and present state of telegraphy. We are told, for example, that by means of the automatic system as many as 130 words per minute can be transmitted on *short* circuits. Now it is a well known fact that from 230 to 250 words per minute are daily transmitted between London and Aberdeen.

We are also informed that "after the telegraphing is finished the clockwork is stopped and the strip torn off, and the message written up in ordinary characters," and also that "'duplex working' has been applied with great success to the automatic system, but *two* clerks are necessary at each station, one to attend to the transmitter while the other is engaged at the receiver!" "Duplex" working is defined "as the system by *which two messages are sent simultaneously along the same wire between two stations.*" This is the definition of "diplex working," but not of "duplex working" which is the system by which messages are sent simultaneously in oppposite directions along the same wire.

We have already referred to the apparatus illustrated for the localising of faults. The handbook makes the principle obvious, but a form of Wheatstone's bridge would have been not only more simple, but more in keeping with daily practice.

Notwithstanding these defects and a few others, such as the different meanings given to the word *local*, when used in connection with batteries, the handbook is well adapted for the purpose it is meant to serve, being plainly and simply written, a desideratum in scientific books for school use.

On the artistic and lithographic work we have no blame, but much praise to bestow. The illustrations are excellent, and will doubtless command the success they so well deserve.

Books Received.

Tratado de Telegrafia. Par DON ANTONIO SUAREZ-SAAVEDRA. Tome I.: *Historia Universal de la Telegrafia.*

Les Telegraphes. Par A. L. TERNANT.

La Telescopie Electrique. Par ADRIANO DE PAVIA.

Des Applications du Telephone et du Microphone. Par Dr. M. BOUDET de Paris.

Questions on Magnetism and Electricity. By F. W. LEVANDER.

Correspondence.

THE THERMO-ELECTROPHORE.

To the Editor of THE TELEGRAPHIC JOURNAL.

(TRANSLATION.)

SIR,—On the 19th of March last I made a communication to the French Academy of Sciences on the result of experiments I had made on the transformation of heat into electricity (Comptes-Rendus de l'Academie Français des Sciences, 12th April, 1880). Full details of these results were inserted in *Verkehrs und Industrie Zeitung, Bedblatt der Neue Freie Presse*, and in other journals.

I have received since this date from various places a number of letters asking if my thermo-electrophore is of the same nature as a thermopile.

I have the honour to request you to kindly insert the following in your next issue:—

The thermo-electrophore has nothing in common with the thermopile. This apparatus is based upon a new principle discovered by me; the causes of the formation of atmospheric electricity, the origin of the electricity in the Armstrong machine and in others is explained upon this principle. But, what is most important, I have constructed on the basis of this principle an apparatus in which heat is transformed immediately into a current of electricity and with very little loss of energy. The obtaining* of electricity in my thermo-electrophore takes place at the time of the passing of the vapours of certain liquids to the solid state, at the moment when the solorific movement of the vapour becomes transformed, according to my researches, sufficiently completely into electro-molecular movement, or current.

By means of certain arrangements I am even confident of utilising the heat of the air.

If I am able to render my apparatus practicable, according to my calculations, it will be possible to obtain electricity (steam engines and Gramme machines utilising only a tenth part of the heat obtained from the coal consumed) to the extent of two-thirds of the heat expended.

I believe even that by combining the thermo-electrophore with the Gramme machine (which arrangement I call the dynamophore) it will be possible to obtain a motor relatively very light (approximately four times lighter and consuming a proportionately less amount of coal in comparison with the steam engine of equal power).

Accept, Sir, the assurances, &c.,

GREGOIRE BABITSCHEFF.

Vitebsk, *Dec.*, 1880.

VYLE'S RELAY.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—I have observed in your recent issues two letters respecting the relay made by me and described in the TELEGRAPHIC JOURNAL of the 15th of November, 1880, and I shall be obliged by your allowing me to make the following remarks.

In the description of my relay it is distinctly set down that the principle is not a new one (although at the time the idea first suggested itself to me I was not aware of the arrangement of Professor Hughes, type printer), and as Mr. Brown, of Birmingham, and Mr. Bolton, of Bow, lay claim to having made similar arrangements, I desire to point out that there must always exist a marked distinction between the early and crude efforts exemplifying new ideas and the mature

* The patents have not been yet obtained, or the description of the apparatus would have been published.

and perfected instrument, the result of close attention to the requirements and adaptation of details to produce finished results, and this is the marked distinctive peculiarity of my relay or direct sounder in comparison with those of the gentlemen named. It is a well-known fact that one of the most troublesome, and at times annoying, defects of the present form of relay is the fresh adjustment required, as the line varies in resistance consequent on the changes in the weather or alteration of battery power, especially in duplex working. In the relay designed by me this is almost entirely done away with, and it may be interesting to your readers to know that it is possible to work this relay with a single current key and ten chamber cells through 10,000^w, which can be increased to 100,000^w without any alteration in the adjustment.

The maximum speed of this form of relay has not yet been determined, but in actual work on a long line, it has given satisfaction at 130 words per minute; a higher speed would have been tried, but this was the "top" of the transmitter.

The same instrument will act as a direct line sounder, single or double current, and has worked direct double current on a wire 100 miles in length during a week of wet weather, without any complaint, on a circuit fully occupied.

In conclusion, I desire to say that I have no wish to depreciate any other form of apparatus acting upon a similar principle, but simply to claim that the relay in question is superior to any previous attempt in this direction, and that the facts given above are sufficient evidence to substantiate the claim.

I am, Sir, Yours faithfully,

London, *December 27th*, 1880. C. C. VYLE.

Proceedings of Societies.

THE SOCIETY OF TELEGRAPH ENGINEERS.

AN ordinary general meeting of this Society was held on Wednesday, December 22nd, Mr. W. H. PREECE (President) in the chair. The minutes of the last general meeting having been read and confirmed, the SECRETARY read the annual report of the society.

The report stated that 5 foreign members, 5 members, 46 associates, and 1 student had been added to the society, or a total of 57. Also 17 new members would be added to this number by the 1st of the month. The losses by deaths, resignations, &c., were 29.

A list of the papers which had been read during the year was then noticed, and it was pointed out that several of these papers, especially those on the electric light and the photophone, had been elaborately illustrated by diagrams and apparatus.

In the new numbers of the journals of the society copious extracts from other journals had been made.

The completion of the Ronald's catalogue, it was stated, had caused great satisfaction and had been very favourably noticed by foreign papers and journals; indeed, the demand for the catalogue was so great as to lead to the probability that it would soon be out of print. The completion of the binding of the library and the way in which it had been executed had been warmly approved. The existence of the library had been referred to by Mr. Spottiswoode in his address to the Royal Society.

£50 per annum had been voted for the necessary expenses in connection with the library for the purchase of new books, &c.

Several new works had been added, and it was stated that all the new Electrical Patent Specifications would be laid on the table of the library each week.

The report of the committee on the establishment of a new wire gauge was being considered by the Board of Trade.

In order to allow of more time being available for the arrangement of apparatus for illustrating the lectures it was intended in future that the meetings of the society should be held on Thursday instead of Wednesday, as heretofore.

The application for the incorporation of the society by royal charter, which had been required to be made under the terms of the Ronald's trust, had been made and had been refused; it was hoped, however, that under a recent Act of Parliament the charter might be obtained.

The proposal for changing the title of the society had been considered by the council, and it was proposed that the words "and of electricians" should be added. The members had been written to with reference to the proposals, and out of 353 replies received only 17 dissented.

The financial position of the society was very satisfactory, inasmuch as the loan which had been granted for wiping off the debts of the society had been extinguished in two years instead of seven years, as was originally proposed.

At the conclusion of the report,

Mr. E. BRIGHT and Mr. NEWMAN seconded that the report be adopted. Votes of thanks to the INSTITUTE OF CIVIL ENGINEERS for the use of their lecture hall, to Mr. GRAVES, the honorary secretary of the society, to Mr. BRISTOW, honorary solicitor, were unanimously passed.

The meeting then proceeded to discuss the question of changing the title of the society, in which discussion Mr. A. SIEMENS, Mr. FOSTER, Mr. DONOVAN, Mr. ALMACK, Professor AYRTON, and others took part. The motion being put by the chair, that the title be altered as recommended, was carried.

Motions with reference to certain changes and additions in the composition of the council were also carried.

Mr. F. C. WEBB, having suggested that an index to the series of volumes of the transactions of the society would be valuable, Professor AYRTON, the chairman of the editing committee, stated that an index was being prepared by Mr. Frost, the librarian of the society.

The result of the ballot for the new council for 1881 was then announced as follows:

President—Professor G. C. Foster, F.R.S. *Past Presidents*—Charles William Siemens, F.R.S., D.C.L., Frank Ives Scudamore, C.B., Sir William Thomson, LL.D., F.R.S., Latimer Clark, C.E., C.V. Walker, F.R.S., Professor Abel, C.B., F.R.S., Lieutenant-Colonel J. U. Bateman-Champain, R.E., W. H. Preece, M. Inst. C.E. *Vice-Presidents*—Lieutenant-Colonel C. E. Webber, R.E., Willoughby Smith, Professor W. G. Adams, F.R.S., C. E. Spagnoletti, M. Inst. C.E. *Hon. Treasurer*—Edward Graves. *Hon. Secretary*—Lieutenant-Colonel Frank Bolton. *Council* (Members remaining in office)—W. S. Andrews, William T. Ansell, Sir Charles Bright, H. G. Erichsen, Colonel Glover, R.E., Professor D. E. Hughes, F.R.S., Augustus Stroh, C. F. Varley, F.R.S. New names—Edward B. Bright, H. C. Forde, M. Inst. C.E., Alexander Siemens. *Associate Members of Council* (New Names)—Lieut. P. Cardew, R.E., R. E. Crompton, John Fletcher Moulton, F.R.S.

THE PHYSICAL SOCIETY.—DEC. 11, 1880.

PROF. W. G. ADAMS in the chair.

New members—Mr. W. R. BROWN; Mr. T. WRIGHTSON, C.E.

LIEUT. L. DARWIN read a paper on the "law of loss of light from phosphorescent substances." His experiments were made at Chatham, on Balmain's luminous paint, by comparing the intensity of the phosphorescent

light with the light of a sun-burner, the luminous surface being kept cool by placing ice and water near, as a slight increase of temperature in the surface considerably increases the quantity of light given off in a certain space of time. The supply of light was communicated to the paint from a mirror reflecting sunlight. A table and a curve, exhibited to the meeting, showed the rate of loss found by Lieut. Darwin. It is independent of the original intensity of the illumination. According to the curve the light diminishes very nearly in proportion to the square of the intensity of the light. In a report on the use of Balmain's paint in mines, it had been stated that the phosphorescence became brighter a few minutes after exposure in the dark; but the curve showed this to be an error, due probably to the fact that the eye becomes more sensitive to light after being a few minutes in the dark.

Mr. PEARSALL emphasised the advantages of such a light in fiery mines.

Prof. GUTHRIE inquired if the phosphorescent power grew weaker by time?

Lieut. DARWIN instanced a specimen eighty years old to the contrary.

Dr. W. CROOKES stated that in sulphuretted hydrogen and damp air these luminous substances deteriorated. If sealed in a vacuum they would not. Dr. Crookes remarked that in Balmain's patent it was stated that the phosphorescence died out sooner when exposed to a strong light for a short time than to a weak light for a longer time.

Lieut. DARWIN thought this was explained by the slow decrease in the lower part of the curve when the phosphorescence became faint.

Mr. R. J. LECKY mentioned that Evelyn in his diary (1658) describes a phosphorescent powder as "bottling-up" sunlight.

Dr. COFFIN inquired if short exposure to strong light was equivalent to long exposure to feeble light?

Lieut. DARWIN thought not.

Dr. C. R. ALDER-WRIGHT read a full paper on the "Determination of chemical affinity in terms of electro-motive force." He considered first the value of the B.A. unit of resistance which, from different experimenters, might be taken as really 1·005 earth quadrants per second, or not more than ½ per cent. out. Clark's element, when carefully prepared, was practically correct at 1·457 volts, and it kept constant for three or four months after being made, but deteriorated thenceforth some 3 per cent. in about two years. The deterioration was assisted by air, which could not be well excluded by the paraffin cork, as it cracked. If sealed in a Sprengel vacuum the element lasted better. Joule's mechanical equivalent of heat (J) he estimated at 42×10^6, or not over 1 per cent. greater than Joule's water value. The chief result of Dr. Wright's researches was the conclusion that the action of a current in electrolysis is to decompose the electrolyte into "nascent" products, which evolve heat in changing into ordinary products of electrolysis. These nascent products may be the ultimate atoms composing the molecules of the ordinary products, and the heat is given out in these atoms coming together to produce molecules, say of oxygen and hydrogen in the case of water. A number of deductions from this theorem are verified by experiment. One of these is that no gas battery can give an higher E.M.F. than 1·5 volts. Another result, not before published, is that the E.M.F. of a Daniell cell is a function of the current, and is a maximum when the current is indefinitely small. The variation may amount to 10 degrees. Therefore all methods of determining internal resistance by means of two currents of different strength are inaccurate.

Prof. ADAMS inquired if Dr. Wright had seen the letter of Prof. Rowland's assistant, to the effect that Dr. Wright's former estimate of the ohm was on the wrong side of unity?

Dr. WRIGHT.—I have been too busy to see it.

Prof. FOSTER thought that the variation of E.M.F. in a cell with the current was to be expected, and was probably due to the slowness of diffusion.

Dr. WRIGHT thought that diffusion would account for it.

Dr. LODGE said that there was no way of measuring the resistance of a cell except by employing two currents of different strength, and therefore it was necessary to know the law of variation of E.M.F. with current strength.

Dr. WRIGHT stated that he had found two methods of proceeding with currents of the same strength.

With regard to the deduction of Dr. Wright, that no current passes without producing electrolysis, Mr. WALENN inquired if the ordinary law of solution held when there was no evolution of hydrogen, and was answered in the affirmative.

Prof. GUTHRIE cited the experiments of Mr. C. V. Boys and himself on the conductivity of liquids as an instance of a current passing without electrolysis, or if there was decomposition, it was followed by instant recomposition.

Dr. WRIGHT thought there must be electrolysis in Dr. Guthrie's experiments (which were conducted by rotating a glass vessel filled with the liquid between the poles of a magnet, after Arago's experiment), because some two parts of the rotating vessel would be at different potentials, and a current would be set up in the liquid.

The Society then adjourned till after Christmas.

New Patents—1880.

5068. "Improvements relating to telephonic and other systems of electrical communication." J. N. CULBERTSON and J. W. BROWN. Dated December 6.

5083. "Improvements in the manufacture of cables for telegraphic and telephonic purposes and in apparatus employed therein." E. BERTHOUD AND F. BOREL. Dated December 6.

5091. "Improvements in the means for communicating intelligence by electricity, and in telegraphy by induced currents." H. J. HADDAN. (Communicated by S. L. M. Barlow.) (*Complete.*) Dated December 7.

5092. "Magneto-electric speaking telephony." H. J. HADDAN. (Communicated by S. L. Barlow.) Dated December 7. (*Complete.*)

5113. "Telephones." J. B. MORGAN. (Communicated by T. A. Edison.) Dated December 8.

5137. "Improvements in dynamo-electric, magneto-electric, and electro-magnetic machinery and apparatus for the production of light and heat, the transmission of power, and for other useful purposes, and in electric lamps." W. T. HENLEY. Dated December 9.

5141. "Magnetic apparatus, or machinery for separating iron articles or particles from wheat or other grains, either whole or in their various stages of reduction, flour, and other like substances." T. M. CLARK. Dated December 9.

5152. "Electric drills." S. PITT. (Communicated by C. E. BALL.) Dated December 9. (*Complete.*)

5162. "Transmitting and receiving apparatus of printing telegraphs." H. VAN HOEVENBURGH. Dated December 10.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1880.

1720. "Attachment of telegraph and other conducting wires to insulators." John Rowlands Edwards. Dated April 27. 2d. In fastening the line wire on to the insulators it is usual to attach it with binding wire. This process is very wasteful of wire; the binding wire wears out sooner than the line wire, and after a time the latter falls. Sometimes, too, the binding wire comes undone, and the ends hanging down spoil the insulation, not merely of their own line wire, but of such other line wires as they touch. The new invention consists in making a wire clip in the shape of a ring welded at the joint of good stiff wire, and of such dimension that when in position, as hereafter described, it will still hold the line wire slightly bent round the insulator with a tight grip. In applying the clip or ring, it is first doubled till the two halves nearly touch; this is done in the manufacture. The line wire is placed between the two loops formed by the doubled ring. The doubled ring or clip is then placed over the top of the insulator, and by a lever forced down into the groove. The strain on the line wire, as well as the rigidity of the ring, prevents any tendency to its becoming loose, and the line is held as in a vice between the insulator, bulging it slightly out and the two loops. (*Provisional only.*)

1738. "Permanent and electro-magnets, &c." Samuel Russell. Dated April 28. 6d. Relates to the construction of magnets either permanent or electro, and also to their application to telephonic and

FIG. 1

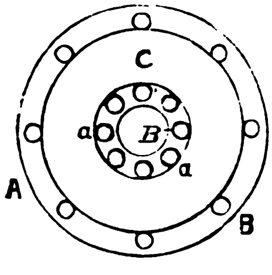
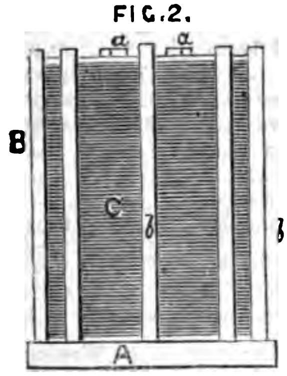


FIG. 2.



telegraphic purposes; and its second part also relates to the construction of magnetic telephones for both transmitting and receiving, and to the connection therewith of transmitting telephones, which operate by varying the resistance to the passage of a battery current. An electric coil, c, of conducting wire is arranged in the annular space between the two rows of poles, as shown in figs. 1 and 2. Fig. 1 is a plain or end view of the magnet with the coil in place, and fig. 2 is a side elevation of the same. When a current circulates through this coil, it will pass outside of the poles, *a*, *a*, and inside of the poles, *b*, *b*, thus acting oppositely upon each in accordance with their opposite polarisation, and it will act to temporarily increase or decrease their magnetism, according as it flows in one direction or the other. In the telephone the armature-diaphragm, instead of being formed of the ordinary sheet-iron plate, which is liable to warp under the influence of several magnetic poles, and thereby to get out of adjustment, is made of wire-gauze formed from fine iron wire, and having its interstices closed or filled by hammering or varnishing.

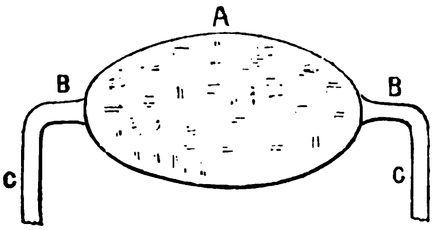
1764. "Telephone apparatus." Richard Theiler and Meinrad Theiler. Dated April 30. 2d. Relates to an improved method of constructing telephonic transmitters, in which the pressure of two contacts against one another is made to vary by the vibrations of a diaphragm or sounding board. (*See* Telegraphic Journal, September 15, 1880. (*Provisional only.*)

1820. "Electrical signalling apparatus for railways." Herbert John Allison. (A communication from abroad by Hugues Bagilet, of Paris.) Dated May 4. 2d. A telegraphic wire connects the two stations, and at each extremity of the wire is an electric apparatus composed of an electro-magnet, and a soft iron bar or armature, which apparatus is situated between the extremities of the wire connecting the two stations, and of a wire connected with a disc. This disc carries on one side a pivotted bar, which is maintained on the red side of the disc by a spring. A strong spring works the rod carrying the disc, which spring is held by a catch, raised at the proper moment by a very strong electro-magnet. A chain connects the disc with a lever situated perpendicularly between the two rails, where it is maintained by two springs. This lever is fixed to a transmission bar which carries at its extremity an angle piece, which serves during the passage of a train to put the wire of the battery in contact with the wire connecting the two stations. As the train passes it pushes down the lever in the direction in which it is travelling, and at the next station the first named electro-magnet under the influence of the current attracts the soft iron bar or armature, which in turning on a pivot puts the wire from the battery in contact with the wire of the disc. The second named electro-magnet raises the catch, which releases the strong spring and turns the disc towards the station. The disc should be on the same side of the station as the train, so that when the train on this line leaves the station when the signal is against it, the bar pivotting on the disc will move either a lever which causes the whistle of the locomotive to be sounded, and thus warn the driver, or a lever which controls the supply of steam to the cylinders, and thus stop the train. (*Provisional only.*)

1824. "Electric telegraphs." Robert Chapman Anderson. Dated May 4. 2d. Relates to improvements in electric telegraphs, chiefly applicable to submarine cables, but also applicable for land lines; and the invention consists in the employment, in place of the ordinary cables or wire for conveying the electric current of a fluid conductor contained within a tube of suitable insulating material. (*Provisional only.*)

1840. "Production of electric light." William Robert Lake. (A communication from abroad by Thomas L. Clingman, of United States of America.)

Dated May 5. 6d. Relates to the production of electric light. For this purpose a small mass in the form of a sphere or spheroid is used, or an elongated cylinder with convex ends, or a hemispherical mass, as shown by the figure. This mass is composed of the oxide of zerconia, or of a mixture of zerconia and plumbago or other form of carbon, or of zerconia and alumina, or magnesia, or lime, or silica, or mixtures with one or more of these substances. The mass when thus composed of zirconia or plumbago, or other substance,



may also be covered with a thin coating or glazing of zerconia or one of the other substances to protect it from the air. This mass or bead is to be supported on each side by wires or pins of platinum, brass, iron, or other metal connected with copper or other metallic electrodes.

1958. "Telephonic exchange systems." JOHN HENRY JOHNSON. (A communication from abroad by George Lee Anders, of Boston, and Thomas Augustus Watson, of America.) Dated May 12. 1s. 8d. Reates to a telephonic exchange system consisting of the combination of a central station, a series of circuits radiating from the said central station, stations on each circuit, apparatus at each station controlled and operated from the central station, which apparatus, when communication is desired at the said station, will give an audible signal at that station only; switching devices at each station for securing secrecy, means at each station for calling the central station without signalling any other station on the same circuit, signalling apparatus at the central station for sending currents of the proper number and character to cause an audible signal at any desired station on the same circuit and a signal at the other stations that the line is in use; and a switch board at the central station, whereby any circuit can be connected with the signalling apparatus at the central station, and any two circuits can be connected together.

1960. "Insulators for telegraph wires, &c." GEORGE WELLS and ARTHUR GILBERT. Dated May 13. 2d. The invention consists of an insulator of earthenware, stoneware, porcelain, or other suitable non-conducting material of bell or mushroom shape, surmounted by a head either square or flat-sided, or so shaped as to receive nuts and bolt-heads conveniently. Through the head of the insulator two (or, if preferred, one) or more bolts are passed by the side of, but clear of contact with, the bolt which passes up the centre of the insulator for securing it to the pole or arm of the pole. These bolts have a small groove cut in the inner side of their heads to grip the wire, and a corresponding groove or bed is made in the earthenware or in a continuous metal washer under the bolt-heads. The wire may be attached to the insulator either at the side by placing the gripping bolts horizontally, or on the top by placing them vertically, or at any angle with the nuts below, aud in either case the wire when strained has only to be placed in position and the nuts **screwed up tight.** (*Provisional only.*)

The following are the final quotations of telegraphs for the 29th ult.:—Anglo-American Limited, 59¾-60¼; Ditto, Preferred, 89-90; Ditto, Deferred, 30¾-31¼; Black Sea, Limited, ——; Brazilian Submarine, Limited, 9⅝-10⅛; Cuba, Limited, 8½-9; Cuba, Limited, 10 per cent. Preference, 16¼-16¾; Direct Spanish, Limited, 2⅝-3⅛; Direct Spanish, 10 per cent. Preference, 12¼-12¾; Direct United States Cable, Limited, 1877, 10¾-11; Scrip of Debentures, 101-103; Eastern, Limited, 9⅜-9⅝; Eastern 6 per cent. Preference, 12¾-13; Eastern, 6 per cent. Debentures, repayable October, 1883, 102-106; Eastern 5 per cent. Debentures, repayable August, 1887, 101-104; Eastern, 5 per cent., repayable Aug., 1899, 104-107; Eastern Extension, Australasian and China, Limited, 10-10¼; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 110-113; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 106-108; Ditto, registered, repayable 1900, 106-108; Ditto, 5 per cent. Debenture, 1890, 102-104; Eastern and South African, Limited, 5 per cent., Mortgage Debentures redeemable 1900, 103-105; Ditto, ditto, to bearer, 103-105; German Union Telegraph and Trust, 10¼-10¾; Globe Telegraph and Trust, Limited, 6⅜-6⅝; Globe, 6 per cent. Preference, 12-12½; Great Northern, 10⅝-11⅛; Indo-European, Limited, 25-26; London Platino-Brazilian, Limited, 5¾-6¼; Mediterranean Extension, Limited, 2¾-3¼; Mediterranean Extension, 8 per cent. Preference, 10¾-11¼; Reuter's Limited, 10¾-11¼; Submarine, 260-265; Submarine Scrip, 2⅛-2⅝; West Coast of America, Limited, 2⅝-3⅛; West India and Panama, Limited, 1⅞-2⅛; Ditto, 6 per cent. First Preference, 6¾-7¼; Ditto, ditto, Second Preference, 6-6½; Western and Brazilian, Limited, 8⅞-9⅛; Ditto, 6 per cent. Debentures "A," 106-110; Ditto, ditto, ditto, "B," 98-101; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 120-125; Ditto, 6 per cent. Sterling Bonds, 104-107; Telegraph Construction and Maintenance, Limited, 35-35½; Ditto, 6 per cent. Bonds, 106-109; Ditto, Second Bonus Trust Certificates, 3⅜-3⅝; India Rubber Company, 17¾-18¼; Ditto, 6 per cent. Debenture, 106-108.

TRAFFIC RECEIPTS.

NAME OF COMPANY.	NOVEMBER.		INCREASE or DECREASE.
	1880.	1879.	
	£	£	£
Anglo-American.........	*	67,380	...
Brazilian Submarine...	†14,574	14,540	Inc. 34
Cuba Submarine	1,900	3,110	Dec. 1,210
Direct Spanish	1,465	1,334	Inc. 131
Direct United States...	*	22,460	...
Eastern	47,669	46,147	Inc. 1,522
Eastern Extension	29,724	26,379	Inc. 3,345
Great Northern	20,800	16,653	Inc. 4,147
Indo-European	...	...	...
Submarine	*	...	...
West Coast America ...	...	...	...
Western and Brazilian	‡9,739	12,337	...
West India	2,393	4,772	Dec. 2,379

* Publication temporarily suspended. † Four weeks.

‡ The traffic receipts of the Western and Brazilian Telegraph Company will, from the 1st of October, be published exclusive of the fifth of the gross receipts payable to the London Platino and Brazilian Telegraph Company, Limited, which fifth has hitherto been included in the amounts published.

THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. IX.—No. 191.

THE TELEPHONE AND UNDERGROUND WIRES.

Now that the Postal Telegraph Department have undertaken the opening up of telephonic communication, the use of underground wires is likely to be considerably extended, as it is not probable that the Post Office will follow the example set by the Telephone Company of spinning huge cobwebs in every direction over the metropolis. Up to the present, fortune has favoured the telephone wires; we have had no heavy and continuous falls of snow, with heavy gales, to work havoc overhead, and possibly for the present winter fortune may still continue favourable, although there are still several weeks to be passed during which the trial of strength, or rather weakness, may come, and then the amount of damage in the neighbourhood of Coleman Street and elsewhere may be serious.

It seems unlikely that the bugbear of "induction" between wire and wire can well be overcome as long as the earth is used as the return circuit. The number of new telephones and devices that have been stated to have overcome the difficulty is not a few, but none have really proved effectual. Up to the present the use of a metallic circuit has been the only means of avoiding the evil.

Mr. Brooks, in his system of underground wires which is now on trial between Waterloo Railway Station and Vauxhall, has employed two insulated wires twisted together to form a metallic circuit; a telephone worked on the latter is quite unaffected by heavy working currents passing in neighbouring wires. If the metallic circuit is composed of two wires picked out promiscuously from the number in the pipe, then the effect of induction is strongly felt, as, in consequence of the two wires not occupying the same relative positions amongst the neighbouring circuits, a balance is not obtained. It seems, then, that in order to obtain success, each telephone will have to be worked on a circuit composed of two wires twisted together; but inasmuch as the resistance of a telephone wire may be comparatively high compared with ordinary telegraphic circuits, there is no reason why the two twisted wires should not be contained in a diameter not exceeding that of the present single-conductor gutta-percha underground work. In our opinion this arrangement is the true solution of the difficulty, and inasmuch as it is only applicable in underground work, it is another argument in favour of the latter. The cost, of course, will be slightly greater than that of the single conductor wire; but this is hardly a matter of great consequence. There can be little doubt but that open work in large towns is doomed, and a cheap and thoroughly practical system of buried work, if it can be devised, will hasten its condemnation.

SEYMOUR'S BALANCE GALVANOMETER.

IN the medical world it is seldom that we see accounts of carefully-conducted electrical experiments with numerical values attached; its practice seems to be conducted in the loosest possible manner, anything but calculated to produce successful results. If the latter do occur, it is perhaps more by chance than skill. This is due mainly to the fact that the great bulk of practitioners treat the subject with great indifference. The idea of benefit received being in proportion to the shocking or shaking of the patient, has undergone severe checks, as many unpleasant, and some few serious, results have attended the usual mode of operation. This has led to frequent inquiry for means of regulating and indicating the power given by a battery. The method generally adopted has been to take advantage of the natural divisions of a battery into cells, and to consider the power given by so many cells as a standard measure of force. This has long been seen to be useless and misleading, and led to the placing of a galvanometer in the circuit, which showed by its deflection the current strength. This was a decided improvement, but in practice, for particular purposes, it fails fully to meet the requirements of the electrician who desires to record as exactly as possible an account of his observations.

A simple, effective, and reliable instrument has recently been devised by the electrician to Guy's Hospital, Mr. P. W. Seymour, which seems exactly adapted for the purpose required, and, indeed, for general use. Its novelty consists in the use of the grain as a unit of strength, and the simple manner in which the grain indications have been rendered equivalent to current strength. The instrument is a vertical galvanometer with the advantages of simplicity of construction and manipulation, and also great delicacy, with almost unlimited range of action and thorough reliability. It consists, as shown by the figure, of a pair of ordinary galvanometer coils* with the usual magnetic needle. At right angles to this needle, and fixed on the same axis, is a long, thin beam of aluminium, divided on its face into lengths equal to the radius of the circle described by the needle in its oscillation; these divisions are still further graduated into $\frac{1}{10}$ths. Weights of known values can be hung on the aluminium beam, and indicate, on the principle of the steelyard, the amount of force exerted by the

* The left-hand coil is removed in the fig. to show the needle.

current passing through the coils. An index dial is in front of the instrument, and a straw index hand is mounted on the axis of the needle.

It is found best to limit the motions of the needle by stops, and to deflect the former in one direction only; but the stops can be movable by a lever to permit the needle full play, so that it can be used as an ordinary galvanometer.

As the magnetic power of the coils acts upon the poles of the needle, which are practically the extremities, the needle may be regarded as a lever with a force applied at its extremity; hence the divisions of the aluminium beam should be graduated relatively to the radius of the circle it describes.

The magnetic power developed in a helix is directly proportional to the current strength passing through the coils, and the mutual action between a magnet and an electro-magnet are directly proportional to the power of the latter multiplied into the former.

The following sets of figures illustrate the accuracy of the instrument by a comparison of calculated and observed results, the first based on Ohm's Law, $C = \frac{E}{r + R}$. The latter experiments were made with a Leclanché battery newly charged. E.M.F., 1·5; resist., 10; galv. res., 750.

EXPERIMENT I.

Number of Cells.	Calculated Results.	Observed Results.	
		Grains of force.	Relative values.
1 cell	1·97	·468	1·872
2 „	3·89	·962	3·848
3 „	5·76	1·375	5·5
4 „	7·55	1·875	7·5
5 „	9·37	2·312	9·248
10 „	17·64	4·335	17·5
15 „	25·	6·25	25·
20 „	31·57	7·875	31·5
25 „	37·5	9.312	37·248
30 „	42·85	10·625	42·5

This is not an isolated experiment, but one taken from several hundreds of a similar kind, and the figures are sufficiently near for all practical purposes; and there can be no doubt, as these were obtained with a comparatively roughly-constructed instrument, that if necessary a nearer approach to calculated results may be secured by giving greater attention to the mode of suspending the needle and beam. Mr. Seymour says he can measure to the $\frac{1}{100}$th part of a grain, which is equal to the $\frac{1}{50}$th part of the force given by a single Leclanché cell, and he considers increased delicacy no practical advantage, unless for special purposes of investigating small forces.

The following set of figures are tests of the various cells in a 30-cell battery, joined up in series, and gives an idea of grain and cell value from a Leclanché battery in fair working condition, the range being from the fraction of a grain to about 11 grains :—

EXPERIMENT II.

Cells tested.	Force in grains.	Cells tested.	Force in grains.	Cells tested.	Force in grains.
1 to 5 ...	2·312	1 to 10 ...	4·375	1 to 15 ...	6·25
5 „ 10 ...	2·312	5 „ 15 ...	4·375	5 „ 20 ...	6·25
10 „ 15 ...	2·312	10 „ 20 ...	4·375	10 „ 25 ...	6·25
15 „ 20 ...	2·312	15 „ 25 ...	4·375	15 „ 30 ...	6·25
20 „ 25 ...	2·312	20 „ 30 ...	4·375		
25 „ 30 ...	2·312				

Cells tested.	Force in grains.	Cells tested.	Force in grains.
1 to 20 ...	7·875	1 to 25 ...	9·312
5 „ 25 ...	7·875	5 „ 30 ...	9·312
10 „ 30 ...	7·875	1 „ 30 ...	10·625

This grain-value refers only to current strength direct from the battery. If the patient be placed in circuit, of course the increased resistance materially diminishes the current.

EXPERIMENT III.

5 cells ranging from ·02 to ·08 grains.
10 „ „ ·1 „ ·2 „
15 „ „ ·2 „ ·3 „
And so on to about ·75 or 1 grain.

The uniform value of each series, as shown in the second series of experiments, is not the rule even with new batteries, for it can only be secured by care in testing each cell, and rejecting those which do not come up to a given standard. The carelessness of workmen causes cells to be imperfectly charged or otherwise defective, and these, inserted among good ones, seriously deteriorate the value of the battery power as a whole. The following, show tests of a battery with defective cells :—

EXPERIMENT IV.

Cells tested.	Force in grains.	Cells tested.	Force in grains.	Cells tested.	Force in grains.
1 to 5 ...	1·65	1 to 10 ...	3·1	1 to 15 ...	3·9
5 „ 10 ...	1·7	5 „ 15 ...	3·1	5 „ 20 ...	3·9
10 „ 15 ...	1·9	10 „ 20 ...	4·	10 „ 25 ...	4·94
15 „ 20 ...	2·	15 „ 25 ...	4·5	15 „ 30 ...	6·3
20 „ 25 ...	2·4	20 „ 30 ...	4·6		
25 „ 30 ...	2·45				

Cells tested.	Force in grains.	Cells tested.	Force in grains.
1 to 20 ...	5·5	1 to 25 ...	5·15
5 „ 25 ...	5·25	5 „ 30 ...	5·2
10 „ 30 ...	8·	1 „ 30 ...	5·35

After testing each cell, and weeding out two very bad ones, the following values were given, which shows great improvement in the battery power :—

EXPERIMENT V.

Cells tested.	Force in grains.	Cells tested.	Force in grains.	Cells tested.	Force in grains.
1 to 5 ...	1·65	1 to 10 ...	3·3	1 to 15 ...	4·63
5 „ 10 ...	2·1	5 „ 15 ...	4·2	5 „ 20 ...	5·95
10 „ 15 ...	2·25	10 „ 20 ...	4·5	10 „ 25 ...	6·30
15 „ 20 ...	2·4	15 „ 25 ...	4·8		
20 „ 25 ...	2·4				

Cells tested.	Force in grains.	Cells tested.	Force in grains.
1 to 20 ...	6·40	1 to 25 ...	7·42
5 „ 25 ...	7·65	1 „ 28 ...	8·55

The last two sets of figures plainly show the uselessness of reckoning the power by cells, for in set 1 to 15 (Ex. 4)= 3·9, and the last in same series 15 to 30 = 6·3, a difference of 2·4 grains, or quite 5 good cells—a result constantly met with even in the ordinary wear of a battery, for the first series, being most often used, are the first to exhaust.

In practice this irregular wear of the battery, although at first sight a disadvantage, affords really a positive benefit, as it supplies the operator with a variety of graduations of battery power.

With this simple instrument physicians and surgeons have now a trustworthy basis for their future investigations, enabling them to be as precise in their electrical prescriptions as with any other remedy, and ere long we may expect to see specified the exact direction and current strength of electricity, with due regard to frequency and duration of application, and by a careful compilation and comparison of results attending this enlightened use, more will be done to define the true value and sphere of usefulness of this force than all the past loose and necessarily unreliable experience.

It is interesting to know the many ways in which such an instrument can be rendered serviceable to the medical electrician. Among others, cases of aneurism, cancer, tumurus, &c., have been frequently submitted to the electrolytic action of the battery to effect relief or cure. Those who have had much to do with the electrolysis of various solutions are fully aware of the importance of fitting, as it were, the battery to the work; slight excess, diminution, or fluctuation materially alters the character of the results, the great desideratum being—

1st.—The right strength of current.

2nd.—To maintain it uniform.

3rd.—The duration of the application.

These must at least be as important in electrolytic

surgical cases, but what that strength of current is which proves most satisfactory and successful has not yet been settled, probably because "so many cells" has been the usual explanation of the strength used, and may possibly account for the fact that while success attended some, failure came to others. With this new galvanometer, and a rheostat in circuit, the current can be measured off to the $\frac{1}{100}$th part of a grain, or the $\frac{1}{50}$th part of a single cell, and the slightest fluctuations of current would be noted by the galvanometer, and could be instantly corrected by the rheostat. Of course the strength of current necessary would vary according to whether it be an aneurism, tumour, &c., and to the character of the latter. A few such cases, with measured doses, would afford certain knowledge.

Electro-galvanic baths are frequently administered with the object of extracting metallic poisons from the body. Some deny its possibility because they have not in their experience seen it accomplished. Others believe it because they have succeeded in obtaining evidence of metallic extractions. Both sides speak from the result of direct experiment—one succeeds, the other fails—hence the opposite conclusions. The failures may result either because there is no metal in the patients, or else the operator did not secure the proper conditions for its extraction. In old cases of lead or mercury poisoning, the effects may remain, without the actual presence of the metal, which nature or medicine may have removed—but in recent cases, according to Mr. Seymour's experiments, metals are successfully extracted by electrolysis. He mentions one case of a man who worked in white lead works, from whom he obtained, on a copper-plate connected with the negative pole of the battery, the outline of the hands and fingers in deposits of lead after ten minutes' action of the battery, while the positive plate under the other hand was free from any deposit. On changing the direction of the current, the same effect was produced from the other hand, and to whatever part of the body the negative pole was placed, it became covered with this deposit, but most rapidly from the hands and arms.

Another case he refers to is one of lead poisoning from drinking water from a lead-lined cistern. No such evidence as in the preceding case was possible, but a bath was prepared, and samples of the water bottled off before the patient's immersion. After being bathed for twenty minutes, samples of the bath water were again bottled, the results of analysis showing the first samples to be free from lead, while the last contained evidences of lead. The experiment was several times repeated with the same care and results.

Success with these cases will depend on—

1st.—The preparation of a bath capable of receiving the metallic salt in solution.

2nd.—The strength of current necessary to effect its dissolution.

3rd.—To place the patient in contact with the right pole of the battery.

To secure the first—If gold, silver, or mercury are the metals to be extracted, a bath must be made of acid hydrochloric, 1 oz. to every gallon.

If lead, then use for the bath acid sulphuric, 1 oz. to each gallon; from twenty to thirty minutes' immersion is quite sufficient. Occasional interruptions of the current, so as to produce muscular contractions, prove serviceable during the bath.

RESISTANCE OF DEW ON THE SURFACES OF INSULATORS.

THE following tests were taken in Madras in 1877 to ascertain the resistance of the deposit at night of moisture on the cups of Prussian pattern (Schomberg) insulators, which had previously passed the usual test in troughs (2,000 megohms each at least). The lot of four insulators was placed at a height of seven feet from the ground and the lot of seven insulators at eleven feet. The yard being paved with brick tiles, which became much heated during the day, would by radiation at night probably occasion a greater dewfall in its neighbourhood than the roads and fields along which the lines usually run. The testing instrument was Thomson's reflecting galvanometer; the battery consisted of 97 Minotto cells.

Date.	Time.	Temp. F. Wet. / Dry.	Number of Insulators.	Resistance absolute in megohms.	Resistance per insulator in megohms.	Remarks on weather.
March 20th.	5·30	74° / 76°	4	157·5	630	Before sunrise. Fair. Clouds at night.
20th.	12·0	...	4	14608	58432	Sun shining.
27th.	6·0	75° / 78°	4	504	2016	Before sunrise. Fair. Clouds at night.
May 9th.	5·45	80° / 83°	7	145·9	1021·3	Moderate dewfall. Slight clouds.
10th	12·0	80° / 90°	7	...	...	Sun shining.
11th.	5·40	79° / 82°	7	115·6	809·2	Slight dew. Scattered clouds.
11th.	12·20	83° / 91°	7	...	...	Sun shining.
12th.	5·30	80° / 83°	7	25·6	179·2	Rather heavy dew-clouds.
12th.	14·20	84° / 91°	7	...	...	Sun shining.
13th.	14·0	84° / 91°	7	150·1	1051	While water was being poured over them from above.
15th.	5·30	75° / 79°	7	100	700	Clear sky. No wind.
15th.	11·20	77° / 90°	7	...	...	Sky overcast.

These insulators are found to be as efficient as any in use on the Indian lines, ensuring as they do, under the most unfavourable circumstances, a resistance per mile of not less than two megohms. (The lowest result above obtained, viz., 25·6 for seven insulators, gives for a mile of twenty insulators 8·9 megohms.) They have been in use for nine or ten years on the through line from Madras to Bombay—eight hundred miles, and have been with excellent effects lately introduced on the main wire from Madras to Calcutta for about eight hundred miles of its length. Though very variable in amount in India, dew is not to be feared as an impediment to communication in the absence of dirt, webs, cracked insulators, and true contacts.

AN IMPROVED TELEPHONE.

By W. E. FEIN, STUTTGART.

In the construction of the telephone to be described the electro-magnet is not as usual manufactured of solid iron, but is composed of a large number of well insulated thin iron plates or iron wires. By this arrangement the electro-magnet changes its magnetism very quickly, so that the inducting effect is very considerable. The shape of the electro-magnet too is different from that generally adopted; the lateral section is segmental, producing thereby a uniform central attraction at the diaphragm, which greatly increases the purity of the sounds. The segment-shaped armatures are further surrounded handle. The size and shape of the magnet has a favourable influence on the production of a strong magnetic force, and therefore on the efficaciousness of the telephone. The centre of the segment-shaped electro-magnets is in the same line with that of the diaphragm.

By this arrangement the attraction of the diaphragm is quite uniform, and its vibrations regular; the sounds of speech are transmitted clearly and distinctly.

The electro-magnets, composed of iron plates or wires, are surrounded by the coils, E and E^1, the distance between these two being regulated by a special contrivance. Between the two bars of the steel magnet the brass lever, O, is placed; this lever is movable on one end, between two screw points; at the other end it is kept in position by the screw, S,

FIG. 1.

FIG. 2.

FIG. 3.

by semi-circular coils, the given space thus being completely made use of and allowing the coils being wound with a wire of the greatest possible length; these telephones may in consequence be used for working over great distances or through high resistances.

The improved telephone requires no special alarm or signal apparatus, the sound of a small reed or whistle being sufficient to produce a distinctly audible signal at the station to be called.

Fig. 1 shows the external view of the telephone one-third actual size; fig. 2 shows the internal arrangements, with speaking-funnel and membrane screwed off; fig. 3 is a section of the same.

The horseshoe steel magnet, M, has its poles mounted with the armatures, T and T^2, its bent portion projecting out of the wood box, H; this projecting part may conveniently be used as a by turning which the lever is made to move up or down; a strong spiral spring prevents any end play of the screw; the head of this screw passes through the back plate of the instruments, and can be turned by a screw-driver. The two electro-magnets are screwed on to the lever, O, and their distance from the diaphragm may be varied without altering the position of the steel magnet. The wire ends of the coils are joined to the two terminals, P and P^1, to which are connected the conducting wires.

THE TELEPHONE CASE.—We hear that as yet no notice of appeal against the judgment in this case has been given. It seems probable that no appeal will be made.

TELEGRAPHIC APPARATUS IN USE IN THE BRITISH POSTAL TELEGRAPH DEPARTMENT.

XXV.

THE WHEATSTONE AUTOMATIC SYSTEM.

(Continued.)

THE RECEIVER.

BEFORE considering the local connections of the "Transmitter," it will be convenient to refer to the general arrangement of the "Receiver." The electro-magnet which works the recording arrangement in the Wheatstone Receiver is exactly similar to that in the Post Office standard relay (Article V., March 15th, 1880), and, as in the latter instrument,

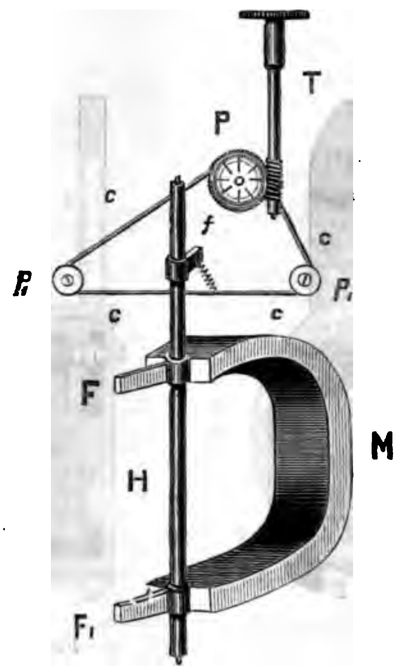


FIG. 99.

there are two soft iron tongues, fixed on an axis, and polarised by a permanent D-shaped magnet. This permanent magnet is shown by M, Fig. 99; F, F_1, show the soft iron tongues, which latter play between the poles of the electro-magnets.

Midway between the tongue, F, and the top of the axle, H, is fixed a small tongue, *f*, to the end of which is fixed one extremity of a small spiral spring; the other end of the latter is attached to a link in a fusee chain, *c*, *c*; this chain passes under two pulleys, p_1, p_1, and also over and around a third pulley, P, in whose edge teeth are cut. Into the teeth in P a screw, cut on the fingerscrew, T, gears; by turning the latter the pulley, P, is rotated, and the fusee chain, *c*, *c*, moved round to the right or left. If the lower end of the spring is drawn by the chain to a position exactly under the end of the tongue, *f*, then the tongues, F, F_1, on the axle H, have no bias either to the right or to the left; if however, by turning the fingerscrew, T, the end of the spring be drawn either to the right or left, then a corresponding bias, due to the tension of the spring, will be imparted to the tongues, and their movements can thus be regulated. The front of the pulley, P, is graduated, and a small index pointer, *n* (shown in fig. 101) is fixed close to the graduations, by means of which the regulation can be adjusted to any degree. It is seldom, if ever the case, however, that these divisions are made use of or referred to.

From fig. 100 (in which fig. the small tongue, *f*, is omitted) it will be seen that at the top of the axle-H, a long bent tongue, J, is fixed, turned in the same direction as the tongue, F. At the bent end of this tongue a hole, J_1, is drilled, through which the axle, A, passes; a portion of the metal on the right hand side of the hole, J_1, is filed away, so that the side of the axle, A, projects slightly; the latter is

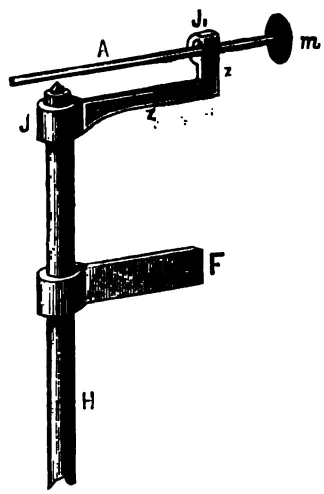


FIG. 100.

kept in its place by means of a spring, *z*, *z*, whose end is screwed to J.

At the end of the axle, A, the small wheel, *m*, is fixed, which corresponds to the inking disc in the Direct Writer instrument (Article IV., March 1st). The paper slip, upon which marks are made by the wheel in being pressed against it, moves in close proximity to the latter, as will be seen in fig. 101, where *m* is shown by dotted lines.

The wheel, *m* (fig. 101), has its circumference in close proximity to a large disc, *d*, the lower part of which dips into an ink-well, I. Both *m* and *d* are kept rotating by means of the same train of clockwork which draws forward the paper slip. The rotation of *d* in the ink-well causes its periphery to be continually coated with ink, and *m* being in close proximity to *d*, the former takes up ink from the latter, and thus itself has its periphery kept continually wetted with the ink, and ready to mark the paper slip when pressed against it.

Referring to fig. 101, it will be seen that the paper slip passes between two rollers, Q, Q_1, the

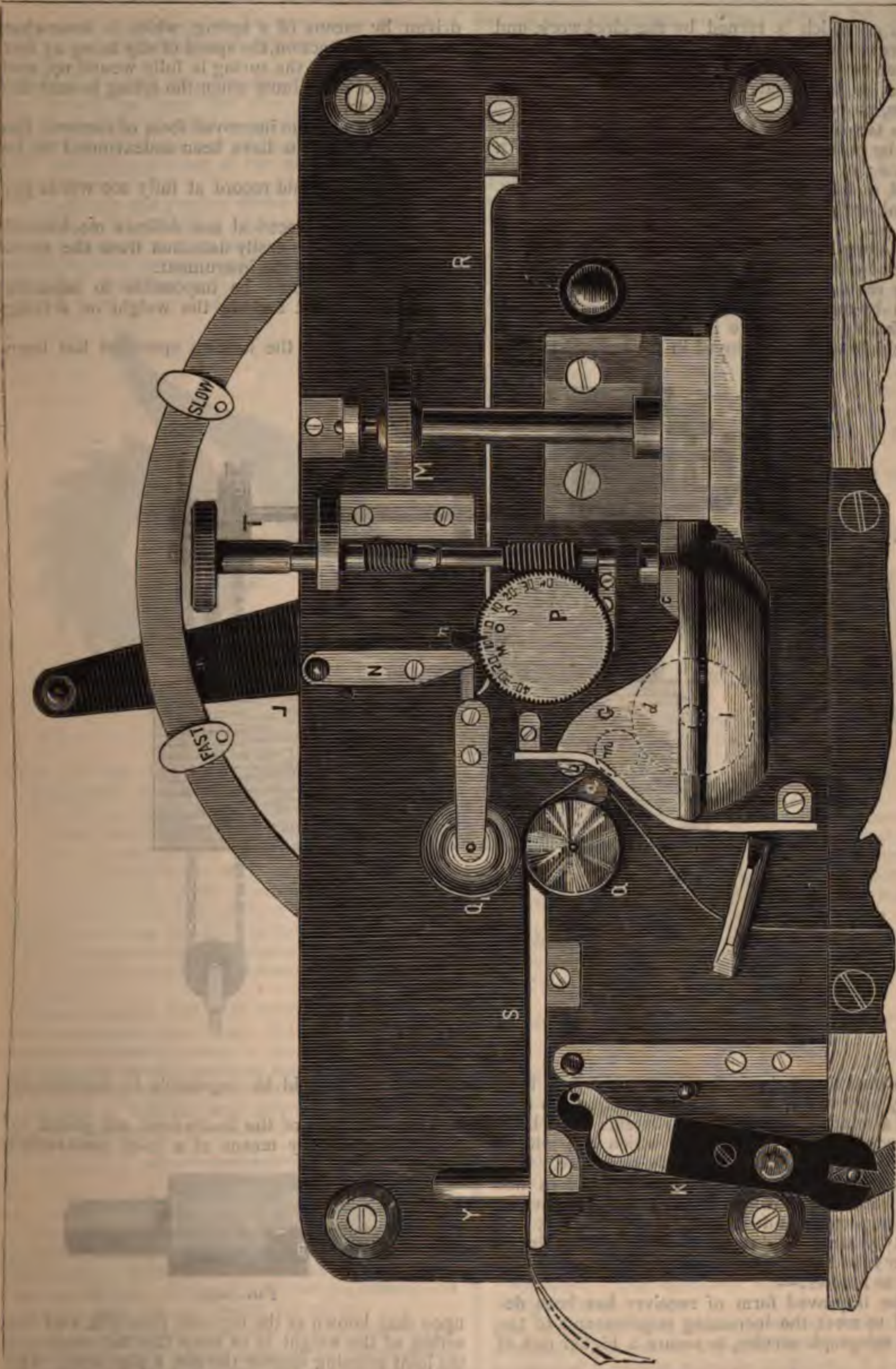


FIG. 101.

former of which is turned by the clockwork, and imparts motion to the slip. The paper also passes between two projecting pieces, *a* and *b*, which keeps its motion steady at the point where the inking disc, *m*, moves.

The two discs, *m* and *d*, are covered over normally by means of a hood, G, fixed by means of a screw, *c*; by unscrewing the latter, G can be removed, and the discs, *m* and *d*, got at if necessary. The ink-well is secured in its place by the thumb-screw, M.

The stopping and starting of the clockwork is effected by the hand-lever, K.

The regulation of the speed of running is controlled by means of the lever, L; the mechanism for effecting the change in the velocity is similar in principle to that employed in the transmitter.

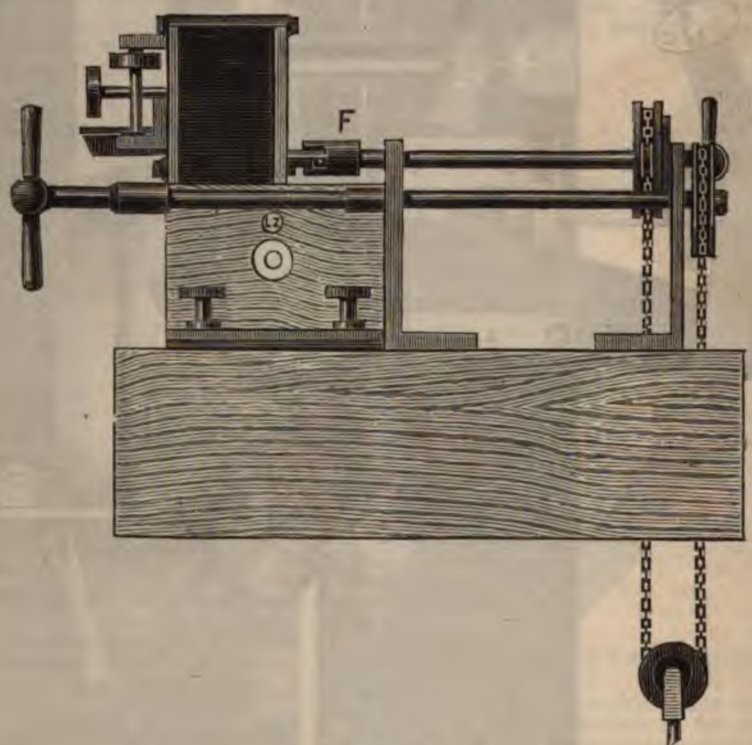


FIG. 102.

The instrument shown by fig. 101 is driven by a spring, and will run at a velocity equal to 120 words a minute. Recently instruments have been introduced, driven by a weight, which run with a velocity equal to over 200 words a minute. The general mechanism of this instrument does not differ from that shown in fig. 101, but it possesses some important and ingenious peculiarities, designed by Mr. J. Willmot, and described by him in a paper read before the Society of Telegraph Engineers, as follows:—

"The improved form of receiver has been designed to meet the increasing requirements of the postal telegraph service, to secure a higher rate of speed.

"The present form of Wheatstone's Receiver is driven by means of a spring, which is somewhat irregular in its action, the speed of slip being 25 feet per minute when the spring is fully wound up, and only 19 feet per minute when the spring is near the end of its action.

"In designing the improved form of receiver, the following conditions have been endeavoured to be fulfilled :—

"1. That it should record at fully 200 words per minute.

"2. That the electrical and delicate mechanical portions should be easily detached from the more substantial parts of the instrument.

"3. That it should be impossible to separate them without first locking the weight or driving portion.

"4. That when the locking operation has been performed, it should be impossible to accidentally release it.

"The two parts of the instrument are joined or geared together by means of a joint constructed

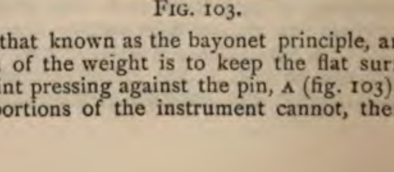


FIG. 103.

upon that known as the bayonet principle, and the action of the weight is to keep the flat surface of the joint pressing against the pin, A (fig. 103). The two portions of the instrument cannot, therefore,

be separated, on account of the projecting part, B, of the socket preventing the withdrawal of the pin referred to.

"Referring to fig. 104 (representing the locking gear), it will be seen that the click wheel and 'pawl' are rather peculiar in shape, and that when the 'pawl' is placed in gear with the wheel it becomes locked, on account of the teeth of the wheel being undercut.

"To separate one portion of the instrument from the other, it is necessary to raise the 'pawl,' E, until it passes its central position; the spring, C, then comes into operation, and presses the 'pawl' against the click wheel, D. By this means the weight is brought to a standstill, and is securely

FIG. 104.

locked until the click wheel is turned (by means of a handle fixed at the right-hand end of the axle carrying the socket, F, fig. 102) into such a position as to permit of the 'pawl' being easily disengaged.

"When the weight has been brought to a state of rest (as already described), the pin, A, is carried forward, by reason of the momentum acquired by the trainwork, into the position shown in fig. 103. The parts can now be easily separated.

The instrument has been worked upon a London and Liverpool circuit at a speed of 250 words per minute.

"It is intended that that portion of the instrument comprising the paper draws, weight, &c., shall be permanently fixed in the operating rooms, and that the smaller portion, containing the more intricate parts, should only be sent between the workshops in London and the various telegraph stations throughout the country."

Reviews.

Tratado de Telegrafia. Par DON ANTONINO SUAREZ-SAAVEDRA, licenciado en ciencias exactas. Segunda edicion. Tome I.: *Historia Universal de la Telegrafia.* JAIME JEPUS, Barcelona.

THIS is a well got-up book, and reflects credit upon the author, and is a good addition to the scientific literature of Spain, which is not over rich in books dealing with telegraphy. We know of no work which deals so fully with the very early history of telegraphy, that is to say with the period at which the *electric* telegraph was not thought of.

The chapter on batteries describes all the well-known forms, and also numerous modifications which are not employed to any great extent, but which form links in the chain of this branch of the subject. Evidently every available source has been ransacked to obtain information, and this has been done in an exhaustive, though concise manner, highly creditable to the author. This careful search into the existing literature on the telegraph is a marked feature in the book, and has enabled the author to give an immense amount of information, though this has been done without making an unwieldy volume.

A great fault in the work is a want of illustrations, which are far too few to make the explanations intelligible, but to have illustrated to the necessary extent would probably have added too much to the cost of the book, the circulation of which must necessarily be limited.

We must add that the work is carried well up to date.

Les Telegraphes Par A. L. TERNANT. Hachette et Cie., Paris.

THIS is an excellent little work, well got-up and well illustrated. Forsaking the usual order of things, M. Ternant places the telephone first in describing the electric telegraph. The first chapter gives a description of the heliograph. This, we believe, is the first description of this instrument in any book on telegraph y.

Chapter III. deals with the pneumatic tube system, which is fully and clearly described.

The construction and laying of cables is very completely gone into, illustrations of the machinery for manufacturing the cable, both core and sheathing, being given The arrangement of the paying out gear is also described and illustrated in a very satisfactory manner; in fact, the book of M. Ternant's is the only one we know of where the mechanical branch of submarine telegraphy is dealt with.

Although the chapters on the telegraph instruments are not long, a wonderful amount of excellently illustrated matter is given, all well up to date.

The description of the duplex system shows very completely the arrangements both for land lines and submarine cable, Muirhead's artificial cables being explained.

The chief fault we have to find with the work is that there is not enough of it. M. Ternant is, we are sure, capable of greater things, and it is to be hoped that he will bring out at some future date an enlarged edition of this book; in the meantime, we wish the latter the success which it thoroughly deserves.

La Telescopie Electrique. Bassée sur l'emploi du selenium. Par ADRIANO DU PAVIA. José da Silva, Porto.

THE object of this *brochure*, as set forth in the preface, is to obtain a public opinion upon the priority of a certain scientific question, this ques-

tion being the invention of an electrical telescope, based upon the variation of the resistance of selenium by the action of light. The author has formed certain ideas from which he theoretically forms the invention in question; but these ideas he has never put into practical shape. We think it is going rather far to claim the invention of an instrument upon such imperfect and unmatured theories.

Book Received.

Telegraphic Tales and Telegraphic History. By W. J. JOHNSTON, New York.

Notes.

SIEMEN BROTHERS AND COMPANY, LIMITED.—We have been favoured with a copy of a circular, issued by Messrs. Siemens Bros., in which it is stated that the firm have incorporated themselves mainly with a view of taking advantage of the provisions of the Companies' Acts, and that the three partners of the firm of Siemens Brothers will continue to hold the bulk of the capital of the new company, and that the board of the new company, will be constituted as follows: Dr. C. William Siemens, chairman; Dr. Ernst Werner Siemens, Mr. Carl Heinrich Siemens; Mr. L. Loeffler, managing director.

M. A. BARTOLI has recently investigated the laws of galvanic polarisation. On measuring the polarisation of the single electrodes in different solutions the author finds that the polarisation of the positive electrode is equal to that of the same electrode when used as a negative pole, as long as the polarisation is far from its maximum. When near the maximum the polarisation of the negative electrode is somewhat greater in solutions of hydrobromic or hydriodic acid, equal for both electrodes in water and hydrochloric acid; in bromiferous hydrobromic acid and iodiferous hydriodic acid the polarisation of the positive electrode is naturally much greater. In case of copper and silver electrodes in dilute sulphuric acid the polarisation by oxygen disappears almost entirely.—*Wiedemann's Beiblätter.*

PROF. BLYTH has constructed an electric sonometer, consisting of a wire monochord, which, traversed by an interrupted electric current, was set into strong vibrations between the poles of a horse-shoe magnet. The notes given out were loudest when they were harmonics of the fundamental interrupted note which was sounded by a vibrating tuning-fork inserted in the circuit.

EXPERIMENTAL RESEARCHES ON FEEBLY MAGNETIC BODIES.—By H. Silez.—The author concludes that with an increase of separative power the magnetising function of a solution of ferric chloride first increases and then again declines, as with iron itself.—*Wiedemann's Beiblätter.*

THE Postal Department of Switzerland is authorised to establish a system of telephonic communications at Bâle, where 62 subscribers have been already obtained. The department is also authorised to establish telephones in any towns where the number of subscribers is sufficient.

FROM some experiments made by M. Mercadier it seems almost conclusively proved that the effects observed in Professor Bell's photophone are due to heat only. Receiving discs were tried which were coated with silver on the side next the light: the effects were feeble. When coated with absorbent lamp-black the effects were strong.

ON ELECTRIC POLARISATION BY METALLIC PRECIPITATES.—D. Macaluso.—According to Lippmann the polarisation of a negative metallic-electrode in a solution of another metal is perceptible, but disappears on adding a small quantity of a salt containing the metal of the electrode. Macaluso has arranged experiments to test this conclusion. It was found that the polarisation of a negative copper electrode in a solution of zinc sulphate, contrary to the statements of Lippmann, is still perceptible when the solution contains traces of blue vitriol, and this the more the shorter the time since interruption of the circuit. This decrease of polarisation in time is also observed in case of pure solution of zinc. With very small quantities of polarising electricity the polarisation immediately on opening the primary current decreases at first rapidly and then slowly. With larger quantities of electricity the polarisation after interruption decreases very slowly for some minutes and then falls more quickly, but again becomes slow as it approaches zero. With an increasing quantity of polarising electricity the polarisation rises to about 0·92 Daniell. With an increasing proportion of copper the polarisation rises more slowly with the increase of the primary current than when copper is absent.

ELECTRIC LIGHTING.—The Commissioner of Public Works, New York City, has granted Mr. Edison a permit to introduce his system of electric lighting in the lower part of this city.

IT is intended to light the St. Gothard Tunnel by the electric light, the machines supplying the current being worked by the turbines at Airolo and Goeschenen.

GALVANIC EXPANSION.—M. A. Righi finds that if a mirror capable of revolving is fixed at the end of a wire, 1 to 7m.m. in thickness and 1·5m. in length, it does not move suddenly if the current of 1 to 6 Bunsen elements is suddenly passed and again interrupted, though the apparatus would have rendered a change of length of $\frac{1}{10000}$ m.m. perceptible. The length of the wire is gradually affected by the evolution of heat.

THE MELBOURNE EXHIBITION.—The collection of telegraphic apparatus exhibited in the British Court of this Exhibition is of a very satisfactory character. The Telegraph Construction and Maintenance Company exhibit a collection of cables. Messrs. M. Theiler and Sons exhibit an interesting and varied collection of apparatus, including ordinary telegraphic instruments and also block-signalling apparatus of every variety manufactured by this well-known firm.

THE THERMIC OR GALVANOMETRIC LAWS OF THE SPARKS IN INDUCTIVE DISCHARGES.—E. Villari.—In short sparks the development of heat is approximately proportional to the length. In those of a medium length there appears scarcely any connection, and in very long sparks the heat rapidly decreases.—*Wiedemann's Beiblätter.*

IN the month of August the president of the Institute of Civil Engineers received official intimation from the

Privy Council Office that a petition had been presented to the Queen in Council for the grant of a Royal Charter of Incorporation to the Society of Telegraph Engineers, and the President's opinion was invited as to whether the provisions contained in the draft charter were such as to interfere in any way with the rights and privileges of this Institution. As in the unanimous opinion of the Council no just or sufficient reasons existed for the grant of a second charter within the same profession, they embodied their objections to such a proceeding in a letter, a copy of which is given in the annual report of the Institute. The action of the Council did not arise from any want of friendly feeling towards the Society of Telegraph Engineers, inasmuch as the Institution had always shown a readiness and a desire to promote the welfare and prosperity of that Society; but the Council submit that it is neither expedient nor advisable that any society, having like objects with those which the Council believe have been faithfully and honestly carried out by the Institution of Civil Engineers, should be incorporated by Royal Charter.

YVON ZOCH has described a new kind of electric dust-figures, which he regards as having an important bearing upon the theory of discharges in vacua, being in opposition to the views of Crookes. Tubes of 1 to 3 centims. diameter, and from 10 to 30 centims. in length, were closed at both ends by corks pierced to receive copper wires. In the tubes were placed various powders, bronze powder being chiefly used in preference to others, which being lighter, adhered to the sides of the tube. One wire was then connected with the positive conductor of an electric machine; from the other the repelled electricity dissipated itself into the air. In other cases the discharges of Leyden jars were employed. The experiments were all conducted at atmospheric pressure. When thus treated the bronze powder arranged itself in beautifully-marked ridges of strata, varying in regularity according to the original distribution of the powder. A space free from all traces of powder was observed to surround the positive pole. Usually there was a corresponding accumulation about the negative pole. These ridges or striations may be compared to the stratifications observable in Geissler-tubes; and Herr Zoch shows that variations in the strength of the electric discharges, in the width of the tubes, &c., produce upon these figures similar effects to those they produce on the luminous striæ of vacuous tubes. In this present case a mechanical repulsion of the particles lying near the poles undoubtedly takes place; and the author of this research believes that the presence of light at the poles of the Geissler tube may be similarly accounted for on the hypothesis that the luminous regions are those of less density than the non-luminous. Since the bronze powder is heaped up mostly about the negative pole the inference is that at the negative pole of a Geissler tube the residual gas has a greater density than at any other part. The stratifications produced by electric discharges through flames may be similarly explained; and these researches have an obvious bearing on the structure of Lichtenberg's well-known figures.—*Nature*.

THE RADIANT MATTER OF THE ELECTRODES.—M. J. Puluj shows that most of the phenomena observed by Crookes had been previously described by Hittorf. He does not accept the view of Crookes on a fourth state of aggregation. The author shows, further, that the thickness of the dark space is not determined by the mere length of the passage of the molecules. A plate-shaped cathode was fixed in the midst of a cylindrical tube, and the thickness of the dark space, d, was measured at various pressures, p; if it had been proportional to the mean transit, $p.\ d$, would be constant, since the mean length of transit would diminish proportional to the pressure, but this is not the case.

For air, the mean length, l, is at $p = 0{\cdot}06$m.m., $l = 0{\cdot}9$; if $p = 1{\cdot}46$m.m., $l = 0{\cdot}04$, so that there is no agreement between l and d.

The author has also seen the green light at far higher tensions (0·04) than Crookes (0·00076m.m.). He ascribes the cause of the phenomena to metallic particles, charged with electricity and thrown off by the electrode. These strike against the sides of the tube. He shows by the manner in which they are deposited upon the side that these particles are repelled by the magnet. That no deposit appears on the sides in case of aluminium electrodes he explains by the adhesive relations of this metal to glass. He has also examined in some bodies the phosphorescent light under the influence of the rays of the cathode, and with a blue emerald he has, like Crookes, obtained a splendid crimson colour. Carbonised paper, after being heated for some time to whiteness by the action of the rays of the cathode, showed a phosphorescence, possibly due to microscopic diamonds. If disc-shaped electrodes are used, the discharge passes from them at very low tensions to and along the side, as was shown by means of a magnet. The exterior became strongly electro-positive. If the tube has been so far exhausted that the phosphorescence appears faint, and only the faint blue clouds of the cathode rays are to be seen, they disappear if the tube is touched at the negative electrode at the side farthest from the positive pole, and the tube becomes brilliantly phosphorescent. A touch elsewhere is without effect. Bodies placed within highly-exhausted tubes become strongly electric under the influence of the rays of the cathode. According to Hittorf and Goldstein this phosphorescence is due to rays of high refrangibility. In order to refute this supposition, the author interposed a plate of quartz through which the ultra-violet rays would pass; nevertheless the cathodic rays were completely intercepted. The author explains the phosphorescence by assuming that the ether, free from particles of the electrodes, and carried along as electricity, seeks an exchange with that enveloping the molecules of matter upon which it infringes, and thus gives rise to vibrations. In case of a rectilineal electrode repeatedly twisted, the author, like Goldstein, observed in the phosphorescent light an alteration of dark and bright phosphorescent lines. The decrease of phosphorescence which Crookes observed in places which had been struck by the discharge for some time, Puluj seeks to explain by assuming that it has become coated with a metallic layer of the matter of the electrodes. Carbon, heated in the centre of the cathodic rays, yields a very bright white light, and may possibly be used as an electric light. The author explains the deflection of the cathodic rays by the magnet by regarding the escaping particles, charged with electricity, as elementary currents, to which the law of Laplace may be applied, as has already been done for the explanation of the phenomena observed by Plücker at the negative pole.—*Wiedemann's Beiblätter*.

ELECTRIC LIGHTS IN BROADWAY, NEW YORK.—Last year the New York Board of Aldermen passed a resolution requesting the Gas Commission to cause experiments to be made with electric lights, with a view to testing their adaptability for lighting streets, avenues, parks, and squares. No action was taken by the commission until recently, when permission was granted to the Brush Electric Light Company to test their system at their own expense on Broadway, from 14th to 34th Street, a distance of a mile. The posts for the

new lamps are now being set up, and it is promised that the lights will be in operation by Christmas. The iron lamp posts are twenty feet high from the base to the foot of the lamp. Their upper portions are supplied with projecting teeth, which are intended to be used as steps by the men assigned to keep the lamps in good condition. The lamps are constructed in accordance with the Brush patent, being from four to five feet in height and surmounted with an iron hood.

The whole number of lamps will be twenty-two; the wires will be carried from the top of one post to the top of the next for the present, or until the city decides to adopt the system, when they will be sunk under ground. Each lamp will, it is promised, give a two thousand candle-power light, equal to about one hundred gas lamps.

The central station will be at No. 133, West 25th Street, where the Corliss engines and boiler which operate the electric generators have been placed. About twenty-five horse-power will be required for the twenty-two lamps, and one wire will convey the current to the entire series. It is promised that the light will be much cheaper than gas light of equal power. The success of the Brush system elsewhere reduces this experiment to a test of cost and the ability of the lamps to satisfy the requirements of the public eye.—*Scientific American.*

THE American District Telegraph Company, in New York, have recently placed in a number of their offices telephones for public use. By means of this extension of facilities parties who wish to talk with subscribers of telephone exchanges in New York City, Brooklyn, Jersey City, Newark, Paterson, Elizabeth, Orange, Yonkers, and Coney Island, can do so under certain restrictions for five minutes, on paying a fee ranging from twenty to forty-five cents, according to distance. The next improvement will be the establishment of telephone stations, through which conversation may be had by appointment with non-subscribers.

IN a paper read before the National Academy of Sciences, New York, Professor H. Morton gives the results of some experiments made by him on the electro-motive force of the Brush dynamo-electric machine.

These experiments show that each pair of coils on the armature of the machine develops a fluctuating electro-motive force, the projection of which gives a kind of oval curve around the centre of a diagram.

When these curves for each pair of coils are combined, it is found that they show a kind of eight-lobed figure with intersecting lines in certain places. These intersections, if compared with the positions of the commutator, are found to coincide exactly with the points at which rupture of circuit occurs, and thus show that each pair of coils is thrown out, not at the point where its force is least, but at that at which its electromotive force is equal to that from which it breaks; thus suppressing a spark, but only at a certain sacrifice of theoretical efficiency.

M. C. NAUDIN, from experiments in a field in the south of France, has been enabled to confirm the interesting conclusion of Grandeau, that plants which are sheltered from atmospheric electricity are in every respect superior to those grown in the open.

THE first application in Glasgow of electricity to street lighting in a permanent form took place recently at the new *Herald* buildings in Buchanan Street. The proprietors have also contracted with Messrs. Anderson & Munro, electric engineers, Glasgow, to light up the public offices and the composing rooms of the *Herald* and the *Evening Times* by electricity. The Gramme machines are those used, driven by an Otto gas engine, supplied by Messrs. P. Watt & Sons—gas thus curiously so far superseding itself. This gas engine also works the cyclic elevator in use during the day. The electric lamps are those invented by Mr. Brockie, formerly of Glasgow.

THE Compagnie Française du Télégraphie de Paris à New York announce that owing to the appearance of a fault in their cable, the nature of which has not yet been determined, it is considered advisable not to accept messages from the public for the present.

AN application for a patent for the photophone was filed at Washington on the 28th of August, 1880, by Bell. The Patent Office *Gazette* of the 7th of December shows that the patent has been granted.—*Science.*

NEW DYNAMO MACHINES.—M. Heinrichs has completed the first of his new machines, and, we believe, has obtained very successful results with it. We hope to allude to them at greater length in an early issue. Mr. Gordon is experimenting with the machine he has recently patented, and will probably be able soon to exhibit some of the results obtained to his scientific friends. From one coil of this machine a light has been obtained sufficient to read newspaper type at a distance of fifty feet. No details as to the horse-power required have yet been ascertained, but the power necessary is thought to be very low.

MR. GORDON's book on electricity has passed very successfully through its first edition, and a second is now to be published by Messrs. Sampson Low and Co.

WE recently had an opportunity of trying the Hunning's transmitter with a Hickley telephone as receiver. By them speech was very perfectly rendered.

AT the meeting of the Physical Society, to be held on the 22nd inst., the following communications will be made:—"On the measurement of small resistances," and, "On a method of comparing the capacities of two condensers," by R. T. Gazebrook.

A NEW USE FOR TELEGRAPH POLES.—An attempt to upset the Pullman Express was discovered on the night of the 12th inst., on the Midland Railway, near Appleby. A thick telegraph pole, which must have been placed on the rails purposely, was cut into three pieces by the night express.

THE LOSS OF THE "INDIAN CHIEF."—A correspondent writing to the *Daily Telegraph* says:—"In reading the account of the loss of the ship *Indian Chief* in your impression of to-day, it seems remarkable that, with all our engineering science and skill, telegraphy or telephony has not been established with our lighthouses and lightships. Had such been the case in the present instance, the Ramsgate lifeboat might have been on the scene possibly many hours earlier."

A TELEGRAM from Falmouth, of the 12th inst., states that the direct Spanish Telegraph Company's cable was on that date connected direct between Falmouth and Bilbao, and congratulatory telegrams were interchanged between the mayors of Falmouth and Bilbao, and Mr. Cox, the Falmouth postmaster, and Senor Mora, the central Spanish director of Madrid.

LARGE TELEGRAPH WIRES.—At the recent meeting of the American Electrical Society in Chicago, Col. C. H. Wilson read a paper on the use of large telegraph wires. He held that the employment of large gauge wires for the quadruplex circuit was an advantage. A No. 4 wire, recently laid between New York and St. Louis, was giving entire satisfaction. The question had been raised whether, in the desire to increase the conductivity of the wires, there was any limit to their size. There was a limit, and the conductivity could be increased by employing different conductors: copper instead of iron wire, for instance. In a discussion which followed, Mr. Somers advocated the use of large wires, and said that their employment had simplified the quadruplex problem.—*Scientific American.*

PHOSPHOR BRONZE TELEGRAPH WIRES.—M. E. Bède, formerly Professor at the Liège University, has recommended the use of phosphor bronze for wires instead of iron, phosphor bronze having four times the conductibility of iron, and being from three to four times as strong as steel. Aerial lines had the advantage of being easily inspected, but the disadvantage of being liable to accident, while underground lines were almost free from accident, but difficult of inspection. That inventor would render great service to telephonic communication who should devise a cheap method of constructing underground lines, that should at the same time permit of easy and complete inspection.—*Scientific American.*

"THE TELEPHONE SUITS."—If England shall now permit the telephone people to take in, transmit and deliver messages by means of the telephone, that action would result in competition fatal, or excessively damaging, to the Government's monopoly, a little whistle for which it paid fifty million dollars. But the whole business strikes the average free American intellect as the necessary outcome of a Government monopoly. It means that a monopoly must, in its own defence, prevent improvements; that it must immediately confiscate any valuable invention; that inventions must be discountenanced, even if not declared contraband, and that, as in the case of the telephone, when America sends them a good thing, it must be put where it will do the least good. All this proves that a Government monopoly can never give to the public the advantages furnished by private enterprise, acting under the spur of two or three lively competitors. Thus comments *The Operator* of New York.

GRAY'S HARMONIC SYSTEM.—A trial of this system took place in 195, Broadway, on December 21, five sides being worked on a Boston circuit. The operators were Messrs. Jackson, Cushing, Richardson, Wilcox, and A. Wright; 2,200 messages were exchanged in nine hours, a general average of 245 messages per hour, or 49 messages per hour to each man. Operator W. H. Jackson's average was 54. The business exchanged, however, was old messages that had previously been sent. The best average made of late on the quadruplex instruments was by Messrs. McLaren and Allen, the former exchanging 432, and the latter 414 in nine hours, being an average of 48 and 46 respectively per hour on regular business.—*The Operator.*

THE UNITED TELEPHONE COMPANY.—In our last issue we mentioned that an extraordinary meeting of this company had been called for the 13th inst. This was done at the requisition of the Right Honourable E. P. Bouverie, M.P., Colonel C. E. Webber, Viscount Anson, and W. P. Bouverie, Esq. At the meeting, Mr. Brand presiding, the Right Hon. E. P. Bouverie proposed and Viscount Anson seconded a resolution to the effect that the "Management of the company has been unsatisfactory." An amendment was then proposed, but not formally seconded that "The meeting, having heard the chairman's reply to the various charges made by a minority of the board, is of opinion that the shareholders should continue their confidence in the chairman and the majority of the board." A protracted discussion then ensued, and eventually, on the amendment being put, it was carried by 54 to 13, it being understood that the adoption of the amendment would involve the retirement from the board of those directors who had signed the requisition for the meeting. The original resolution was of course lost. The chairman then remarked that the majority of the directors had, without much solicitation on their part, received almost spontaneous offers to the extent of 29,997 votes, and so far as he could learn, the only support received by the requisitionists amounted to 2,225 votes. The meeting was then adjourned until the 27th inst., the proceedings closing with a hearty vote of thanks to the chairman.

New Patents—1880.

4782. "An improved method and apparatus for automatically counting the number of letters impressed with obliterating and other stamps." H. FERGUSON and H. R. KEMPE. Dated November 19.

4851. "Current meters." H. LAW. Dated November 23.

5226. "Improvements in the art of transmitting telephonic messages, and in controlling the ground wires of the circuit station instruments from the main or central station, the apparatus and other mechanisms and appliances therefor, and their combination." A. M. FRANKENBERG. Dated December 14.

5237. "Improvements in machinery for braiding, lapping, or otherwise covering telegraph wires, crinoline steel, engine packing, or other cores, with textile or other material for insulating, protective, and other purposes." W. T. GLOVER and G. F. JAMES. Dated December 14.

5268. "Improvements in the mode of, and apparatus for, transmitting drawings, characters, and writings by electricity; parts of which improvements are applicable to ordinary telegraphy." A. W. REDDIE. (Communicated by J. André.) Dated December 15.

5275. "Improvements in, and relating to, means and apparatus for electric lighting; part of such improvements being applicable also to other purposes." D. G. FITZGERALD. Dated December 16.

5319. "An improved alphabet or code system and means or apparatus for communicating intelligence by visible, audible, or other signals." A. M. CLARK. (Communicated by C. G. Burke.) Dated December 18.

5340. "Telephone signal apparatus." W. MORGAN-BROWN. (Communicated by G. H. Bliss.) Dated December 20.

5352. "Dynamo-electric telegraphy." S. PITT. (Communicated by O. Lugo.) Complete. Dated December 21.

5387. "Micro-transmitters." W. JOHNSON. Dated December 22.

5414. "Improved alarm signal for doors, windows, or the like closures. A. C. FARRINGTON. Dated December 23.

5482. "Improvements in, and connected with, telephonic apparatus." C. J. W. WOLLASTON. Dated December 30.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1880.

2020.—"Continuous electrolytic action." CHARLES DENTON ABEL. (A communication from abroad by Leonhard Wollheim, of Vienna.) Dated May 18th. 2d. This invention has for its object to obtain from liquids that are subjected to electrolytic action the continuous separation of the non-metallic solid products of decomposition. For this purpose a long, narrow, but deep trough containing two plates forming the electrodes, of a size corresponding to that of the trough, has at one end near the top the inlet orifice for the liquid to be acted upon, while at the bottom of the other end it has two outlet apertures, one close to each electrode. The liquid to be acted on is made to flow in continuously through the inlet aperture, and in passing along between the two electrodes it is decomposed in proportion to the strength of the electric current. The metallic constituents are deposited upon the respective electrodes, while those non-metallic products that do not escape as gases descend to the bottom of the trough and escape through the outlet apertures. (*Provisional only.*)

2207. "Conductors of lightning." OTTO WOLFF. (A communication from William Michalk, of Deuben, Saxony.) Dated May 31st. 4d. The object of the invention is to avoid the damage which is caused to

lightning-conductors when their points are only screwed on. *a* is the rod; *b*, the point; *c*, a non-conductor; *d*, the conducting wire; *e*, a supple, pliable body. Between rod, *a*, and point *b*, a non-conductor, *c*, is placed, whereby *c* is fitted on to or screwed on to *a* and *b* on to *c*.

2147. "Electric-light apparatus." WILLIAM LLOYD WISE. (A communication from abroad by Jacques Ambroise Mandon, of Paris.) Dated May 26th. 2d. This invention has for its object improvements in electric light apparatus, and relates particularly to a novel method whereby two pencils or carbons, each formed as an arc of a circle, are kept with their upper extremities or poles in proper relative positions, notwithstanding the consumption, wasting, or wear due to the action of the electric current producing the light. To this end each carbon or pencil is carried or supported and balanced by apparatus arranged so that in proportion as the carbon or pencil is consumed or reduced by the action of the electric current, the carbon or pencil will automatically move upward in a circular path about a centre coincident with that of the circle whereof the carbon or pencil represents an arc. (*Provisional only.*)

2235. "Apparatus for communicating between passengers and servants in railway trains." EDWARD GILBERT and ARTHUR EDWARD GILBERT. Dated June 1st. 4d. Relates to new or improved modes and means or apparatus for communicating by signals between the passengers in the carriages and the guard or other servants in railway trains, which apparatus is specially designed to be applied in combination with continuous pneumatic or vacuum brakes to allow passengers to apply these brakes and stop the motion of the train on the occurrence of danger or serious alarm; and the object of which is to render such signalling apparatus certain and efficient in its action, and most easily operated by any railway passenger. The invention consists essentially in using the power of the pneumatic pressure or vacuum which actuates the continuous brakes of a railway train to apply these brakes, and simultaneously cause the display of a semaphore or other visible signal to the guard or driver by the simple action of any passenger pulling a cord, or pushing or pulling a handle or lever in the carriage or compartment, to admit the air to, or allow it to escape from, the pneumatic tubes of the brake. (*Provisional only.*)

2236. "Electric lamp, &c." SIGISMUND COHNE. Dated June 1st. 2d. A cylinder is filled with water or other fluid, as oil, spirits, &c., in which is submerged a movable vessel. The vessel supports two double racks, affixed to a top and bottom crossbars, forming a parallelogram shaped frame, worked perpendicularly by pinions; the carbons are fixed in the crossbars so as to be brought opposite to each other, point to point. When the consumption of the candles commences the vessel ascends, the lower candle rises and the upper one descends in like ratio, and thus the candles are regulated automatically. (*Provisional only.*)

2252. "Electric lamps." GEORGE GUILLAUME ANDRE. Dated June 2nd. 6d. One or more lengths of carbons end for end, socketed or otherwise, are placed in a tubular holder, which supports them throughout their length, and wherein they can slide as required. The holder has a longitudinal slot, wherein works a peg projecting from a sliding sleeve suspended by a cord which passes over a pulley, and has a weight attached to its end. The weight may slide on a guide rod or rods, which may be used for connecting the current. Fig. 1 is a side view, and fig. 2 a part sectional side elevation of a lamp constructed according to this invention. A is the socket fuse plate of the lamp proper, into which the ring for the glass globe or cylinder is screwed; A^1 is a central socket part, to which is screwed the cylindrical tube, A^2, to the top of which the arm or holder, C, for the negative electrode, C^2, is screwed. This electrode is free to slide lightly through a lantern boss on the arm, C, and is fitted with a copper plug, *c*. c^1 is a contact arm passing through a socket in the plate, *a*, with a light contact spring, L^2, at its upper end. At its lower end it passes through a

wire coil of high resistance, and terminates in a terminal for carrying off the negative current; one end of this coil wire is connected to the plate, A, and the other end to the terminal, L^1. D^1 is the holder for the carbon or carbons; it is made of any desired length, the carbon being placed therein end for end, and fitting easily therein. The carbon holder, D^1, is removable, and will, when its carbons are consumed, be replaced by a holder filled with carbons. It is fixed in the cylinder, G, which by a T piece, G^1, or other bar, is connected to or carried down to the floor or base of the lamp standard. The cylinder, G, is in a tube, H, which, by means of plaster of Paris or other non-conducting cement, is fixed in and insulated from the socket, A^2. K, K, are contacts joined to the nipple, H^1, which is screwed into the top of the tube, H. The holder, D^1, has a longitudinal slot, as shown, wherein works the peg, E, carrying the carbon or carbons. This peg projects from the connecting sleeve, E^1, on the endless cord, band, or wire, F, passing round the upper pulley, F^1, and the lower pulley, F^2, (or the cord may, as stated, pass over an

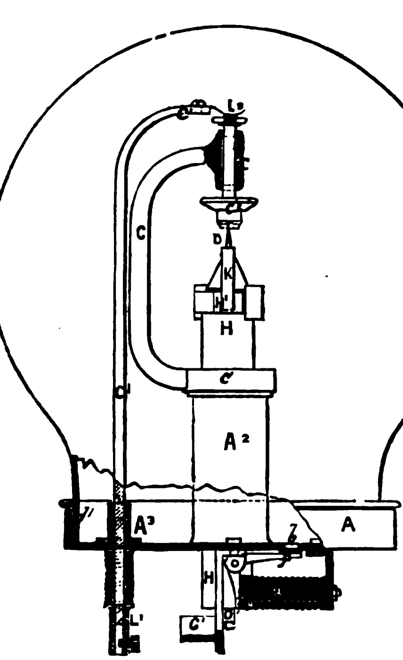


FIG. 1.

upper pulley only, and have the weight suspended from one end, the other end being attached to a guided sleeve with a projecting peg. I is a brake pulley on the spindle of the lower pulley, F^2, with band, I^1, one end of which is fastened to the bar, M, which is fixed to the stand, M^1. The other end of the band is connected to the end of a lever, N, which has its fulcrum in the stand, M^1, and at the other end carries the soft iron core, O, of the solenoid, O^1. The latter is wound with two coils of same resistance, but wound in opposite directions. One coil is by wireto the termifial, L, connected to the arm, C, and the other by wire to the terminal, L^1, connected to the contact arm, C^1. When the carbon point is in its normal position the two currents neutralise each other in the solenoid, but when the contact with spring, L^2 is broken the whole current passes through one of the coils of the solenoid, the core O is raised, the brake band, I^1, is thereby let go, and the brake pulley, I, released, whereupon the weight will move the cord F and raise the carbon. When the contact is then restored at L^2 the core, O, drops and puts on the brake. Obviously the arrangement may be reversed, and the brake be put on when the contact is broken. The high resistance coil on the lower end of arm C^1 forming connection with the plate, A, is for the purpose of providing a circuit for the extra current

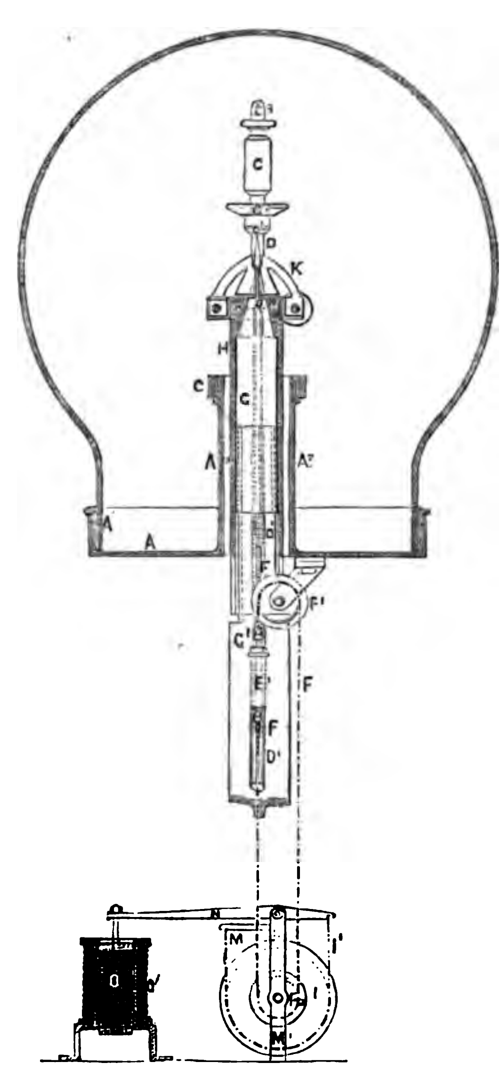
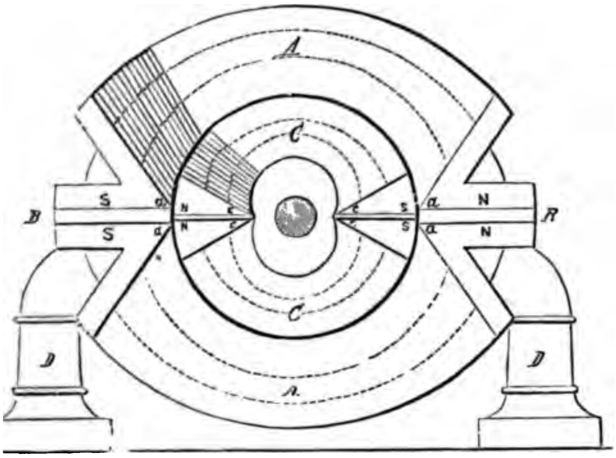


FIG. 2.

occasioned by the break of contact at L^2 to prevent the formation of sparks there. K^1 is the positive terminal on the lower end of the tube, H. *b* is a small hole for automatic air ventilation when the lamp is extinguished.

2272. "Obtaining, increasing, and employing currents of electricity, &c." THOMAS SLATER. Dated June 3rd. 6d. Relates to improvements in obtaining, increasing, and employing currents of electricity, and in apparatus therefor. The fig. 2 is an end elevation of a dynamo-electric machine constructed according to the invention. A, A, are the fixed electro magnets having their like poles, *a*, *a*, opposed and separated by

a strip, B, of non-magnetic material. Each magnet surrounds one half the circumference of the revolving armature, C, and the poles are each brought to a line (as shown) where opposed to the revolving armature. The wire is wound in the direction of the axis of the revolving armature. These fixed magnets are supported by pillars, D, D. The revolving armature, C, is composed of two similar electro-magnets with their like poles, c, c, opposed and separated by a strip of non-magnetic material. The wire is wound on in the direction of the axis, as in the fixed magnets. The



fixed magnets have a constant unbroken current passing through them, whilst the revolving armature has the currents passing it cut off and reversed once in about every 180°. The commutator or collector, and the connecting up are arranged in the usual manner.

City Notes.

Old Broad Street, January 12th, 1881.

The Cuba Submarine Telegraph Company, Limited.—The report of the directors for the half-year ending 31st December, 1880, to be presented at the nineteenth ordinary general meeting of shareholders to be held on the 19th day of January, 1881, states that the gross receipts, including the balance brought from last account, amount to £17,389 19s. 11d., and the gross expenditure to £7,128 2s. 1d., leaving a sum of £10,261 17s. 10d. to the credit of revenue account. The above amount of £7,128 2s. 1d. includes, however, the sum of £3,379 7s. 9d., expended in the attempt to repair the Cienfuegos-Santiago section of the original cable, which the shareholders will recollect broke down in March last, the ordinary expenses (£3,748 14s. 4d.) being about the same as usual. The directors regret to report that the attempt to repair this section has been unsuccessful owing to the cable east of Cape Cruz being in such bad condition as to render it almost necessary to renew the whole of that portion. In order to avoid this great expense, and finding that other parts of this section are not in altogether a satisfactory condition, the directors have entered into a contract by which Messrs. Hooper, of Hooper's Telegraph Works, are to lay and maintain another cable between Cienfuegos and Santiago, on terms which the directors consider will be advantageous to the company. After placing £2,500 to the reserve fund, increasing that fund to £35,365 5s. 8d., and providing for the dividend on the preference shares, a balance of £4,761 17s. 10d. remains, out of which the directors recommend the payment of a dividend on the ordinary shares at the rate of 5 per cent. per annum, free of income tax, leaving the sum of £761 17s. 10d. to be carried forward to the current half-year's account. It will be seen from the accompanying comparative statement of traffic that the interruptions to several of the cables of our allies, the West India and Panama Company, have been more protracted than usual during the past half-year, which accounts for the great falling off in the traffic.

The Union Trust Company of New York have given notice that, in accordance with the provisions of the Deed of Trust excecuted by the Western Union Telegraph Company under date of February 1st, 1875, to the Union Trust Company of New York as trustee, the following number bonds were drawn by lot on the 5th inst. for redemption on the 1st day of March proximo, on which day interest on the said bonds will cease, viz:—

Nos. 53 64 265 331 621 623 654
Seven bonds at £200 each £1,400
Nos. 71 95 113 339 471 539
Six bonds at £100 each 600

£2,000

The bonds named will be paid on presentation at the office of Messrs. Morton, Rose and Co., agents for the loan, Bartholomew Lane, London, E.C., on or after the 1st March next.

The following are the final quotations of telegraphs for the 12th inst.:—Anglo-American Limited, 60¾-61¼; Ditto, Preferred, 88-89; Ditto, Deferred, 32¾-33¼; Black Sea, Limited, ——; Brazilian Submarine, Limited, 9¾-10; Cuba, Limited, 8¾-9¼; Cuba, Limited, 10 per cent. Preference, 16¾-17¼; Direct Spanish, Limited, 2⅞-3⅛; Direct Spanish, 10 per cent. Preference, 12¼-12¾; Direct United States Cable, Limited, 1877, 11-11¼; Scrip of Debentures, 101-103; Eastern, Limited, 9¾-10; Eastern 6 per cent. Preference, 12⅜-12⅞; Eastern, 6 per cent. Debentures, repayable October, 1883, 102-106; Eastern 5 per cent. Debentures, repayable August, 1887, 102-105; Eastern, 5 per cent., repayable Aug., 1899, 104-107; Eastern Extension, Australasian and China, Limited, 10¼-10½; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 110-113; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 104-106; Ditto, registered, repayable 1900, 104-106; Ditto, 5 per cent. Debenture, 1890, 102-104; Eastern and South African, Limited, 5 per cent. Mortgage Debentures, redeemable 1900, 101-103; Ditto, ditto, to bearer, 101-103; German Union Telegraph and Trust, 10¼-10¾; Globe Telegraph and Trust, Limited, 6⅜-6⅝; Globe, 6 per cent. Preference, 11⅝-12⅛; Great Northern, 10¾-11; Indo-European, Limited, 25⅝-26⅛; London Platino-Brazilian, Limited, 5¾-6¼; Mediterranean Extension, Limited, 2¾-3¼; Mediterranean Extension, 8 per cent. Preference, 10¾-11¼; Reuter's Limited, 10¾-11¼; Submarine, 263-268; Submarine Scrip, 2⅛-2⅝; West Coast of America, Limited, 3¼-3½; West India and Panama, Limited, 1¾-2; Ditto, 6 per cent. First Preference, 6¾-7¼; Ditto, ditto, Second Preference, 6-6½; Western and Brazilian, Limited, 7⅝-8⅛; Ditto, 6 per cent. Debentures "A," 106-110; Ditto, ditto, ditto, "B," 98-101; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 120-125; Ditto, 6 per cent. Sterling Bonds, 104-107; Telegraph Construction and Maintenance, Limited, 35⅜-36; Ditto, 6 per cent. Bonds, 103-106; Ditto, Second Bonus Trust Certificates, 3⅛-3⅜; India Rubber Company, 17½-18; Ditto, 6 per cent. Debenture, 106-108.

THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. IX.—No. 192.

ACTION OF AN INTERMITTENT BEAM OF RADIANT HEAT UPON GASEOUS MATTER.

By JOHN TYNDALL, F.R.S.

UNDER the above title the following important paper, relating to photophonic phenomena, has been printed for the Proceedings of the Royal Society:—

Received by the Royal Society January 3, 1881.

The Royal Society has already done me the honour of publishing a long series of memoirs on the interaction of radiant heat and gaseous matter. These memoirs did not escape criticism. Distinguished men, among whom the late Professor Magnus and the late Professor Buff may be more specially mentioned, examined my experiments, and arrived at results different from mine. Living workers of merit have also taken up the question: the latest of whom,* while justly recognising the extreme difficulty of the subject, and while verifying, so far as their experiments reach, what I had published regarding dry gases, find me to have fallen into what they consider grave errors in my treatment of vapours.

None of these investigators appear to me to have realised the true strength of my position in its relation to the objects I had in view. Occupied for the most part with details, they have failed to recognise the stringency of my work as a whole, and have not taken into account the independent support rendered by the various parts of the investigation to each other. They thus ignore verifications, both general and special, which are to me of conclusive force. Nevertheless, thinking it due to them and me to submit the questions at issue to a fresh examination, I resumed, some time ago, the threads of the inquiry. The results shall, in due time, be communicated to the Royal Society; but, meanwhile, I would ask permission to bring to the notice of the Fellows a novel mode of testing the relations of radiant heat to gaseous matter, whereby singularly instructive effects have been obtained.

After working for some time with the thermopile and galvanometer, it occurred to me several weeks ago that the results thus obtained might be checked by a more direct and simple form of experiment. Placing the gases and vapours in diathermanous bulbs, and exposing the bulbs to the action of radiant heat, the heat absorbed by different gases and vapours ought, I considered, to be rendered evident by ordinary expansion. I devised an apparatus with a view of testing this idea. But, at this point, and before my proposed gas thermometer was constructed, I became acquainted with the ingenious and original experiments of Mr. Graham Bell, wherein musical sounds are obtained through the action of an intermittent beam of light upon solid bodies.

From the first, I entertained the opinion that these singular sounds were caused by rapid changes of temperature, producing corresponding changes of shape and volume in the bodies impinged upon by the beam. But if this be the case, and if gases and vapours really absorb radiant heat, they ought to produce sounds more intense than those obtainable from solids. I pictured every stroke of the beam responded to by a sudden expansion of the absorbent gas, and concluded that when the pulses thus excited followed each other with sufficient rapidity, a musical note must be the result. It seemed plain, moreover, that by this new method many of my previous results might be brought to an independent test. Highly diathermanous bodies, I reasoned, would produce faint sounds; while highly athermanous bodies would produce loud sounds; the strength of the sound being, in a sense, a measure of the absorption. The first experiment made, with a view of testing this idea, was executed in the presence of Mr. Graham Bell;* and the result was in exact accordance with what I had foreseen.

The inquiry has been recently extended so as to embrace most of the gases and vapours employed in my former researches. My first source of rays was a Siemens' lamp connected with a dynamo machine, worked by a gas engine. A glass lens was used to concentrate the rays, and afterwards two lenses. By the first the rays were rendered parallel, while the second caused them to converge to a point about 7 inches distant from the lens. A circle of sheet zinc provided first with radial slits and afterwards with teeth and interspaces, cut through it, was mounted vertically on a whirling table, and caused to rotate rapidly across the beam near the focus. The passage of the slits produced the desired intermittence,† while a flask containing the gas or vapour to be examined received the shocks of the beam immediately behind the rotating disc. From the flask a tube of india-rubber, ending in a tapering one of ivory or box wood, led to the ear, which was thus rendered keenly sensitive to any sound generated within the flask. Compared with the beautiful apparatus of Mr. Graham Bell, the arrangement here described is rude; it is, however, effective.

* MM. Lecher and Pernter, "Philosophical Magazine," January, 1881. "Sitzb. der K. Akad. der Wissensch. in Wien," July, 1880.

* On the 29th November: see "Journal of the Society of Telegraph Engineers," December 8, 1880.

† When the disc rotates the individual slits disappear, forming a hazy zone through which objects are visible. Throwing by the clean hand, or better still by white paper, the beam back upon the disc, it appears to stand still, the slits forming so many dark rectangles. The reason is obvious, but the experiment is a very beautiful one.

I may add that when I stand with open eyes in the flashing beam, at a definite velocity of recurrence, subjective colours of extraordinary gorgeousness are produced. With slower or quicker rates of rotation the colours disappear. The flashes also produce a giddiness, sometimes intense enough to cause me to grasp the table to keep myself erect.

With this arrangement the number of sounding gases and vapours was rapidly increased. But I was soon made aware that the glass lenses withdrew from the beam its effectual rays. The silvered mirrors employed in my previous researches were therefore invoked; and with them, acting sometimes singly and sometimes as conjugate mirrors, the curious and striking results which I have now the honour to submit to the Society were obtained.

Sulphuric ether, formic ether, and acetic ether being placed in bulbous flasks,* their vapours were soon diffused in the air above the liquid. On placing these flasks, whose bottoms only were covered by the liquid, behind the rotating disc, so that the intermittent beam passed through the vapour, loud musical tones were in each case obtained. These are known to be the most highly absorbent vapours which my experiments revealed. Chloroform and bisulphide of carbon, on the other hand, are known to be the least absorbent, the latter standing near the head of diathermanous vapours. The sounds extracted from these two substances were usually weak and sometimes barely audible, being more feeble with the bisulphide than with the chloroform. With regard to the vapours of amylene, iodide of ethyl, iodide of methyl and benzol, other things being equal, their power to produce musical tones appeared to be accurately expressed by their ability to absorb radiant heat.

It is the vapour, and not the liquid, that is effective in producing the sounds. Taking, for example, the bottles in which my volatile substances are habitually kept, I permitted the intermittent beam to impinge upon the liquid in each of them. No sound was in any case produced, while the moment the vapour-laden space above an active liquid was traversed by the beam, musical tones made themselves audible.

A rock-salt cell filled entirely with a volatile liquid, and subjected to the intermittent beam, produced no sound. This cell was circular and closed at the top. Once, while operating with a highly athermanous substance, a distinct musical note was heard. On examining the cell, however, a small bubble was found at its top. The bubble was less than a quarter of an inch in diameter, but still sufficient to produce audible sounds. When the cell was completely filled, the sounds disappeared.

It is hardly necessary to state that the pitch of the note obtained in each case is determined by the velocity of rotation. It is the same as that produced by blowing against the rotating disc and allowing its slits to act like the perforations of a syren.

Thus, as regards vapours, prevision has been justified by experiment. I now turn to gases. A small flask, after having been heated in the spirit-lamp so as to detach all moisture from its sides, was carefully filled with dried air. Placed in the intermittent beam it yielded a musical note, but so feeble as to be heard only with attention. Dry oxygen and hydrogen behaved like dry air. This agrees with my former experiments, which assigned a hardly sensible absorption to these gases. When the dry air was displaced by carbonic acid, the sound was far louder than that obtained from any of the elementary gases. When the carbonic acid was displaced by nitrous oxide, the sound was much more forcible still, and when the nitrous oxide was displaced by olefiant gas, it gave birth to a musical note which, when the beam was in good condition, and the bulb well chosen, seemed as loud as that of an ordinary organ pipe.* We have here the exact order in which my former experiments proved these gases to stand as absorbers of radiant heat. The amount of the absorption and the intensity of the sound go hand in hand.

A soap bubble blown with nitrous oxide, or olefiant gas, and exposed to the intermittent beam, produced no sound, no matter how its size might be varied. The pulses obviously expended themselves upon the flexible envelope, which transferred them to the air outside.

But a film thus impressionable to impulses on its interior surface, must prove at least equally sensible to sonorous waves impinging on it from without. Hence, I inferred, the eminent suitability of soap bubbles for sound lenses. Placing a "sensitive flame" some feet distant from a small sounding reed, the pressure was so arranged that the flame burnt tranquilly. A bubble of nitrous oxide (sp. gr. 1·527) was then blown, and placed in front of the reed. The flame immediately fell and roared, and continued agitated as long as the lens remained in position. A pendulous motion could be imparted to the bubble, so as to cause it to pass to and fro in front of the reed. The flame responded, by alternately roaring and becoming tranquil, to every swing of the bubble. Nitrous oxide is far better for this experiment than carbonic acid, which speedily ruins its envelope.

The pressure was altered so as to throw the flame, when the reed sounded, into violent agitation. A bubble blown with hydrogen (sp. gr. 0·069) being placed in front of the reed, the flame was immediately stilled. The ear answers instead of the flame.

In 1859 I proved gaseous ammonia to be extremely impervious to radiant heat. My interest in its deportment when subjected to this novel test was therefore great. Placing a small quantity of liquid ammonia in one of the flasks, and warming the liquid slightly, the intermittent beam was sent through the space above the liquid. A loud musical note was immediately produced. By the proper application of heat to a liquid the sounds may be always intensified. The ordinary temperature, however, suffices in all the cases thus far referred to.

In this relation the vapour of water was that which interested me most, and as I could not hope that at ordinary temperatures it existed in sufficient amount to produce audible tones, I heated a small quantity of water in a flask almost up to its boiling-point. Placed in the intermittent beam, I heard—I avow with delight—a powerful musical sound produced by the aqueous vapour.

Small wreaths of haze, produced by the partial condensation of the vapour in the upper and cooler air of the flask, were, however, visible in this experiment; and it was necessary to prove that this haze was not the cause of the sound. The flask was, therefore, heated by a spirit-flame beyond the temperature of boiling water. The closest scrutiny by a condensed beam of light then revealed no trace of cloudiness above the liquid. From the perfectly invisible vapour, however, the musical sound issued, if anything, more forcible than before. I placed the flask in cold water until its temperature was reduced from about 90° to 10° C., fully expecting that the sound would vanish at this temperature; but, notwithstanding the tenuity of the vapour, the sound extracted from it was not only distinct but loud.

Three empty flasks, filled with ordinary air, were placed in a freezing mixture for a quarter of an hour. On being rapidly transferred to the intermittent beam,

* I have employed flasks measuring from 8 inches to $\frac{5}{8}$ths of an inch in diameter. The smallest flask, which had a stem with a bore of about $\frac{1}{8}$th of an inch in diameter, yielded better effects than the largest. Flasks from 2 to 3 inches in diameter yield good results. Ordinary test-tubes also answer well.

* With conjugate mirrors the sounds with olefiant gas are readil obtained at a distance of twenty yards from the lamp. I hope t be able to make a candle flame effective in these experiments.

sounds much louder than those obtainable from dry air were produced.

Warming these flasks in the flame of a spirit-lamp until all visible humidity had been removed, and afterwards urging dried air through them, on being placed in the intermittent beam the sound in each case was found to have fallen almost to silence.

Sending, by means of a glass tube, a puff of breath from the lungs into a dried flask, the power of emitting sound was immediately restored.

When, instead of breathing into a dry flask, the common air of the laboratory was urged through it, the sounds became immediately intensified. I was by no means prepared for the extraordinary delicacy of this new method of testing the athermancy and diathermancy of gases and vapours, and it cannot be otherwise than satisfactory to me to find that particular vapour, whose alleged deportment towards radiant heat has been most strenuously denied, affirming thus audibly its true character.

After what has been stated regarding aqueous vapour, we are prepared for the fact that an exceedingly small percentage of any highly athermanous gas diffused in air suffices to exalt the sounds. An accidental observation will illustrate this point. A flask was filled with coal-gas and held bottom upwards in the intermittent beam. The sounds produced were of a force corresponding to the known absorptive energy of coal-gas. The flask was then placed upright, with its mouth open upon a table, and permitted to remain there for nearly an hour. On being restored to the beam, the sounds produced were far louder than those which could be obtained from common air.

Transferring a small flask or a test-tube from a cold place to the intermittent beam, it is sometimes found to be practically silent for a moment, after which the sounds become distinctly audible. This I take to be due to the vaporisation by the calorific beam of the thin film of moisture adherent to the glass.

My previous experiments having satisfied me of the generality of the rule that volatile liquids and their vapours absorb the same rays, I thought it probable that the introduction of a thin layer of its liquid, even in the case of a most energetic vapour, would detach the effective rays, and thus quench the sounds. The experiment was made, and the conclusion verified. A layer of water, formic ether, sulphuric ether, or acetic ether, $\frac{1}{4}$th of an inch in thickness, rendered the transmitted beam powerless to produce any musical sound. These liquids being transparent to light, the efficient rays which they intercepted must have been those of obscure heat.

A layer of bisulphide of carbon about 10 times the thickness of the transparent layers just referred to, and rendered opaque to light by dissolved iodine, was interposed in the path of the intermittent beam. It produced hardly any diminution of the sounds of the more active vapours—a further proof that it is the invisible heat rays, to which the solution of iodine is so eminently transparent, that are here effectual.

Converting one of the small flasks used in the foregoing experiments into a thermometer bulb, and filling it with various gases in succession, it was found that with those gases which yielded a feeble sound, the displacement of a thermometric column associated with the bulb was slow and feeble, while with those gases which yielded loud sounds, the displacement was prompt and forcible.

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FURTHER EXPERIMENTS.

Since the handing in of the foregoing note, on the 3rd of January, the experiments have been pushed forward; augmented acquaintance with the subject serving only to confirm my estimate of its interest and importance.

All the results described in my first note have been obtained in a very energetic form with a battery of sixty Grove's cells.

On the 4th of January I chose for my source of rays a powerful lime-light, which, when sufficient care is taken to prevent the pitting of the cylinder, works with admirable steadiness and without any noise. I also changed my mirror for one of shorter focus, which permitted a nearer approach to the source of rays. Tested with this new reflector the stronger vapours rose remarkably in sounding power.

Improved manipulation was, I considered, sure to extract sounds from rays of much more moderate intensity than those of the lime-light. For this light, therefore, a common candle flame was substituted. Received and thrown back by the mirror, the radiant heat of the candle produced audible tones in all the stronger vapours.

Abandoning the mirror and bringing the candle close to the rotating disc, its direct rays produced audible sounds.

A red-hot coal, taken from the fire and held close to the rotating disc, produced forcible sounds in a flask at the other side.

A red-hot poker, placed in the position previously occupied by the coal, produced strong sounds. Maintaining the flask in position behind the rotating disc, amusing alternations of sound and silence accompanied the alternate introduction and removal of the poker.

The temperature of the iron was then lowered till its heat just ceased to be visible. The intermittent invisible rays produced audible sounds.

The temperature was gradually lowered, being accompanied by a gradual and continuous diminution of the sound. When it ceased to be audible the temperature of the poker was found to be below that of boiling water.

As might be expected from the foregoing experiments, an incandescent platinum spiral, with or without the mirror, produced musical sounds. When the battery power was reduced from ten cells to three, the sounds, though enfeebled, were still distinct.

My neglect of aqueous vapour had led me for a time astray in 1859, but before publishing my results I had discovered my error. On the present occasion this omnipresent substance had also to be reckoned with. Fourteen flasks of various sizes, with their bottoms covered with a little sulphuric acid, were closed with ordinary corks and permitted to remain in the laboratory from the 23rd of December to the 4th of January. Tested on the latter day with the intermittent beam, half of them emitted feeble sounds, but half were silent. The sounds were undoubtedly due, not to dry air, but to traces of aqueous vapour.

An ordinary bottle, containing sulphuric acid for laboratory purposes, being connected with the ear and placed in the intermittent beam, emitted a faint, but distinct, musical sound. This bottle had been opened two or three times during the day, its dryness being thus vitiated by the mixture of a small quantity of common air. A second similar bottle, in which sulphuric acid had stood undisturbed for some days, was placed in the beam: the dry air above the liquid proved absolutely silent.

On the evening of January the 7th Professor Dewar handed me four flasks treated in the following manner. Into one was poured a small quantity of strong sulphuric acid; into another a small quantity of Nordhausen sulphuric acid; in a third were placed some fragments of fused chloride of calcium; while the fourth contained

a small quantity of phosphoric anhydride. They were closed with well fitting india-rubber stoppers, and permitted to remain undisturbed throughout the night. Tested after twelve hours, each of them emitted a feeble sound, the flask last mentioned being the strongest. Tested again six hours later, the sound had disappeared from three of the flasks, that containing the phosphoric anhydride alone remaining musical.

Breathing into a flask partially filled with sulphuric acid instantly restores the sounding power, which continues for a considerable time. The wetting of the interior surface of the flask with the sulphuric acid always enfeebles, and sometimes destroys the sound.

A bulb, less than a cubic inch in volume, and containing a little water, lowered to the temperature of melting ice, produces very distinct sounds. Warming the water in the flame of a spirit-lamp, the sound becomes greatly augmented in strength. At the boiling temperature the sound emitted by this small bulb* is of extraordinary intensity.

These results are in accord with those obtained by me nearly nineteen years ago, both in reference to air and to aqueous vapour. They are in utter disaccord with those obtained by other experimenters, who have ascribed a high absorption to air and none to aqueous vapour.

The action of aqueous vapour being thus revealed, the necessity of thoroughly drying the flasks, when testing other substances, becomes obvious. The following plan has been found effective. Each flask is first heated in the flame of a spirit-lamp till every visible trace of internal moisture has disappeared, and it is afterwards raised to a temperature of about 400° C. While the flask is still hot, a glass tube is introduced into it, and air freed from carbonic acid by caustic potash, and from aqueous vapour by sulphuric acid, is urged through the flask until it is cool. Connected with the ear-tube, and exposed immediately to the intermittent beam, the attention of the ear, if I may use the term, is converged upon the flask. When the experiment is carefully made, dry air proves as incompetent to produce sound as to absorb radiant heat.

In 1868 I determined the absorptions of a great number of liquids whose vapours I did not examine. My experiments having amply proved the parallelism of liquid and vaporous absorption, I held undoubtingly twelve years ago that the vapour of cyanide of ethyl and of acetic acid would prove powerfully absorbent. This conclusion is now easily tested. A small quantity of either of these substances, placed in a bulb a cubic inch in volume, warmed, and exposed to the intermittent beam, emits a sound of extraordinary power.

I also tried to extract sounds from perfumes, which I had proved in 1861 to be absorbers of radiant heat. I limit myself here to the vapours of patchouli and cassia, the former exercising a measured absorption of 30, and the latter an absorption of 109. Placed in dried flasks, and slightly warmed, sounds were obtained from both these substances, but the sound of cassia was much louder than that of patchouli.

Many years ago I had proved tetrachloride of carbon to be highly diathermanous. Its sounding power is as feeble as its absorbent power.

In relation to colliery explosions, the deportment of marsh-gas was of special interest. Professor Dewar was good enough to furnish me with a pure sample of this gas. The sounds produced by it, when exposed to the intermittent beam, were very powerful.

* In such bulbs even bisulphide of carbon vapour may be so nursed as to produce sounds of considerable strength.

Chloride of methyl, a liquid which boils at the ordinary temperature of the air, was poured into a small flask, and permitted to displace the air within it. Exposed to the intermittent beam, its sound was similar in power to that of marsh-gas.

The specific gravity of marsh-gas being about half that of air, it might be expected that the flask containing it, when left open and erect, would soon get rid of its contents. This, however, is not the case. After a considerable interval, the film of this gas clinging to the interior surface of the flask was able to produce sounds of great power.

A small quantity of liquid bromine being poured into a well-dried flask, the brown vapour rapidly diffused itself in the air above the liquid. Placed in the intermittent beam, a somewhat forcible sound was produced. This might seem to militate against my former experiments, which assigned a very low absorptive power to bromine vapour. But my former experiments on this vapour were conducted with obscure heat; whereas, in the present instance, I had to deal with the radiation from incandescent lime, whose heat is, in part, luminous. Now the colour of the bromine vapour proves it to be an energetic absorber of the luminous rays; and to them, when suddenly converted into thermometric heat in the body of the vapour, I thought the sounds might be due.

Between the flask containing the bromine and the rotating disc I therefore placed an empty glass cell: the sounds continued. I then filled the cell with transparent bisulphide of carbon: the sounds still continued. For the transparent bisulphide I then substituted the same liquid saturated with dissolved iodine. This solution cut off the light, while allowing the rays of heat free transmission: the sounds were immediately stilled.

Iodine vaporised by heat in a small flask yielded a forcible sound, which was not sensibly affected by the interposition of transparent bisulphide of carbon, but which was completely quelled by the iodine solution. It might indeed have been foreseen that the rays transmitted by the iodine as a liquid would also be transmitted by its vapour, and thus fail to be converted into sound.*

To complete the argument:—While the flask containing the bromine vapour was sounding in the intermittent beam, a strong solution of alum was interposed between it and the rotating disc. There was no sensible abatement of the sounds with either bromine or iodine vapour.

In these experiments the rays from the lime-light were converged to a point a little beyond the rotating disc. In the next experiment they were rendered parallel by the mirror, and afterwards rendered convergent by a lens of ice. At the focus of the ice lens the sounds were extracted from both bromine and iodine vapour. Sounds were also produced after the beam had been sent through the alum solution and the ice lens conjointly.

With a very rude arrangement I have been able to hear the sounds of the more active vapours at a distance of 100 feet from the source of rays.

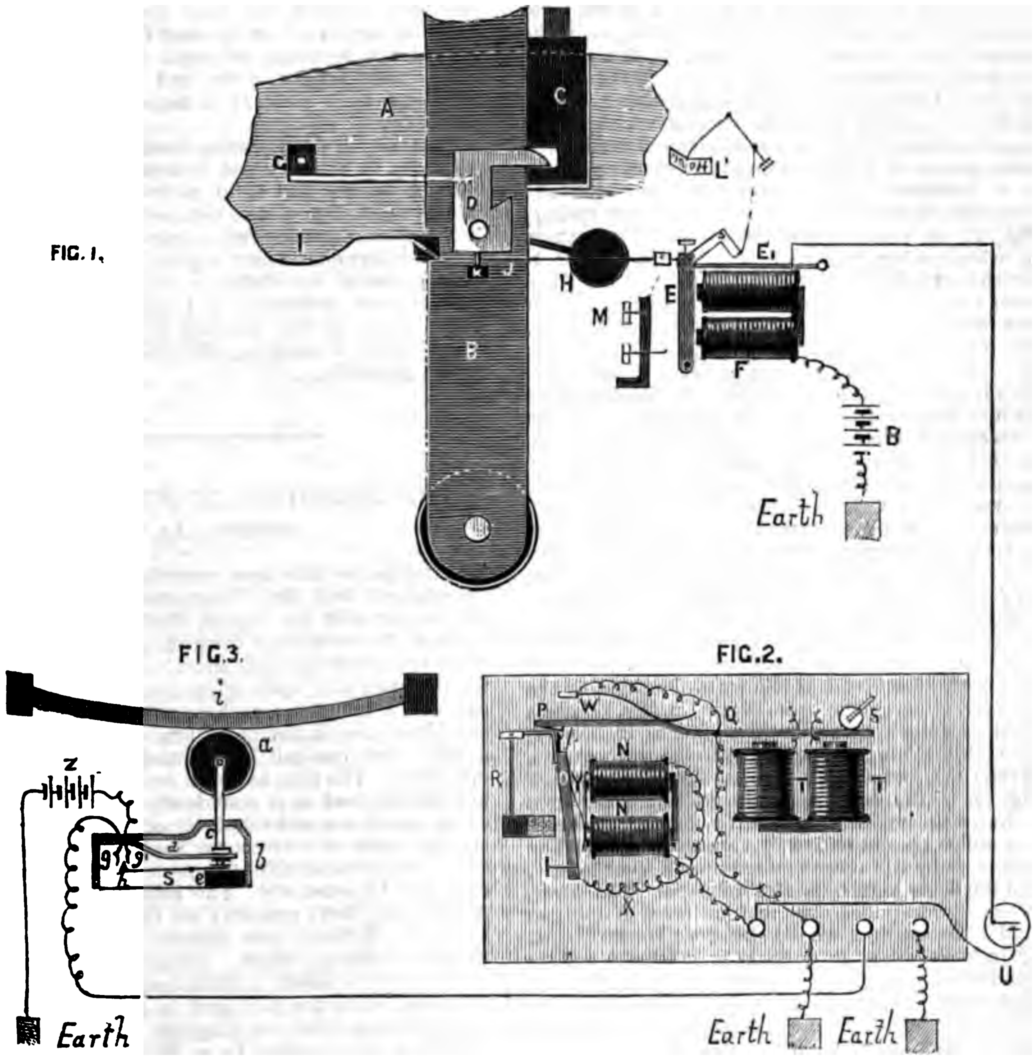
Several vapours other than those mentioned in this abstract have been examined, and sounds obtained from all of them. The vapours of all compound liquids will, I doubt not, be found sonorous in the intermittent beam. And, as I question whether there is an absolutely diathermanous substance in nature, I think it probable that even the vapours of elementary bodies, including the elementary gases, when more strictly examined, will be found capable of producing sounds.

* I intentionally use this phraseology.

SPAGNOLETTI'S RAILWAY SIGNALLING APPARATUS.

The object of this apparatus is the interlocking of the out-door semaphore signals with the block telegraph system by electrical and mechanical means, the trains themselves taking part in the working of the system. The following is the arrangement:—To the signal frame is attached a catch lock working in the lever lock, which catch is duplicated to lock the lever also. Attached to this is a balance weight, and on the lever frame is a spring and stop piece acted on by movement of the lever for relocking it. A coloured disc indicator is attached to the frame to show when the lock is "on" or "off," and also a handle for unlocking the signal lock if required, under lock and key, the latter being kept by the station master or inspector. By these arrangements the knuckle lock of the signal lever, or the lever itself, can be either kept locked or be released at the pleasure of the signalman at the station in advance. An electro-magnet is so arranged as to act upon a small lever bar; when the latter is in its normal position the lever cannot be moved to lower the signal, but when the bar is attracted by the magnet the lever can be moved, the signal lowered, and again be restored to its position of "danger only," and is then again locked. An electro-magnet is also placed in circuit with the line wire with a soft iron armature, and when the current is sent to release the signal the line wire is disconnected, and no second current can be sent to allow a following train to proceed until the previous one has arrived

FIG. 1.



and reset the apparatus to complete the circuit of the line wire, or until the lever allowing the train to enter the next section has been lowered and put to "danger" again. This apparatus is worked electrically by the train or lever. A releasing relay is used with two sets of electro-magnets, one to draw an armature which is caught with a catch and the other to release the catch holding the armature.

Fig. 1 is a view of the locking apparatus; fig. 2 a view of the releasing relay; fig. 3 a view of the re-setting apparatus acted on by train. A is the lever frame; B, the lever; C, the lever lock; D is the electric lock actuated by armature of the electro-magnets; F, the electro-magnets; G, duplicate lock in lever frame; H, balance weight acting on the lock D; I, spring raised by lever B, which allows balance weight to fall and relock signal catch C; J, catch spring; K is stud on lever for releasing spring, I; L, indicator showing "lock on" or "lock off" actuated by armature E; M, adjustment spring; (fig. 2), N, pair of coils attracting the armature, O, which when attracted is caught by lever P, which is insulated at *p*; Q is the fulcrum on which lever P acts and forms connection with the earth or line wire; R is a red and white indicator showing the position of armature O; T, pair of coils also for releasing armature O from lever P, and electrically acted upon by either the attachments to the train or lever on the starting signal lever for the next section, which must be put back to danger to protect the train, and by this action resets the apparatus controlling the section in the rear, as described; U is ordinary plunger with long contact; W is a spring pressing on lever P; X and Y, springs acting on armature O; (fig. 3), *a*, friction roller; *b*, casing; *c*, forked rod carrying roller *a*; *d*, strong spring; *e*, spring block of india-rubber; *f*, multiplying lever; *g*, springs for contact making; *h*, contact piece of required metal; *i*, metal plate attached to carriage, by preference to axle boxes. The mode of action is as follows:—On pressing the plunger, U, the current from battery, B_1 (fig. 1) passes through coils N to armature O, thence to lever P, through fulcrum Q and spring W to the earth or line, as required, and also through the line wire to coils F (fig. 1), to the earth. By the current, armature O is drawn up and locked by P (fig. 2), and armature E is pulled up and locked by spring I (fig. 1). The lock, D, is by this means pulled out of lever lock, C, and duplicate lock, G, is also released. The lever, B, can now be pulled over, and in the act of doing so stud K lifts spring I, when balance weight H falls and again locks the lever by locks or catches D and G; the indicator, L, showing the action for guidance of signalman. On the arrival of the train at the station in advance, metal plate *i* (fig. 3) presses on friction roller *a*, depressing spring *d*, and acting on lever *f*, actuating *h* to make contact between *g* and g^1. Block *e* supports roller *a* and forked rod *c*, by which means electric current from battery *z* to coils T acting on lever P releases armature O to reconnect the line wires; E^1 is a rod, so that armature *e* can be acted upon by hand. This and lever S (fig. 2) are kept under lock and key.

The system of resetting the apparatus at the station in the rear by the movement of the lever that works the starting signal for the next section in advance when it is put to "danger" after the train has left, can be applied in various ways to signal and point levers for sidings, so that the same safety is afforded to trains that do not go further than the station or junction and are shunted to another line or into a siding, which is an additional element of safety in railway working.

For single lines and tunnels this system is admirably adapted, as the lock on the signal lever at each end of the section is controlled by the signalman at the other end, and being worked by one line wire, when a train is once on the line and the line wire severed, the lock for a second train following or for a train to start from the opposite end cannot be taken off until the train on the line actually arrives at the end of its section, so that one train only at a time can be on the section.

Electricity is daily proving itself a still more useful agent to the safe and convenient working of lines of railway, and is of such an elastic nature that its utilities cannot be enumerated, and since its laws are now getting more generally understood railway telegraphists have a good opportunity, from their technical knowledge of railway working, of giving great assistance and advantages to railway officers in the working of their lines, and consequently of securing safety of travelling to the public generally.

THE TELEPHONE IN QUEENSLAND, AUSTRALIA.

THE telephone has been recently introduced into Queensland both for Governmental and private use, not alone at the capital, Brisbane, but also at some of the small coast towns north. In the city, wires have been specially stretched for the purpose, for the most part upon telegraph poles already in use, and a telephone exchange has been instituted capable of the inclusion of fifty circuits, of which number over one-half have already been placed in operation. The plan has been embraced only some few months, and it is confidently anticipated that, as the excellence and simplicity of this pleasing and speedy mode of intercourse becomes realised by the public, considerable extension of the convenience will be necessary. The Edison carbon transmitters and Bell's receivers are the instruments in use, while Edison's pole changer works admirably in the Exchange room. Remark may here be made that it is found, notwithstanding some of the telephone wires are stretched to a length of from one to sixteen miles on telegraph poles conveying in places six or seven busy Morse lines worked by closed circuit, induction from these latter currents gives little or no trouble, in no case interfering with the successful working of the telephone.

The terms upon which telephonic communication is conceded to the general public, either with the Exchange or between business or private houses, are that the Government provides and maintains the lines for a rental of £5 per mile per annum, and those participating in the benefit supply and keep in working order the required in-

struments, which, by regulation, must be *solely* used for their *own* business. For distances over five miles special arrangements can be made. And it is computed that the revenue to be derived from this source will yield more than remunerative interest upon the cost of construction and maintenance of the private sections of such lines.

RECENT IMPROVEMENTS IN LIGHTING BY ELECTRICITY.

ON Wednesday afternoon Mr. R. E. Crompton read a paper at the Royal United Service Institution on the above subject before a large audience. Mr. Nicholson occupied the chair.

Mr. Crompton said that the year 1880 would be looked back to as a year of great progress in the history of the electric light. The commencement of the year was marked by the natural reaction in public feeling, consequent on the disappointment which followed on the collapse of Edison's famous promises. His great name as an inventor had been used as a lever by unscrupulous manipulators of gas stock to depress their value to such an extent that it had most disastrous consequences to many of the holders, and part of the discredit which should have fallen solely on the ring of speculators who created the panic fell upon the electric light itself, and had most materially retarded its progress and general introduction. However, the various electric light companies had fought down that feeling at great expense to themselves by allowing a free trial of their apparatus, and had succeeded in restoring public confidence. A great wave of interest had been excited in the subject, which he believed would lead to the general adoption of the electric light. Some better lighting was a necessity of modern life. Darkness, that bugbear of the tactician, that friend of secret night surprises, must be under our control. Taking the principles which underlay the production of the light, and also the improvements that have been brought forward during the past year, he divided his subject into two heads—first, the production of the current of electricity; secondly, the transformation of this current into light.

(1). Sir Humphrey Davy discovered the light eighty years ago, but so long as the battery had to be relied upon it was impossible to introduce the light generally. A great impulse was given to the subject by Faraday when he discovered the main principles of dynamic electricity; another stride was made when the French workman Gramme combined with this dynamic electricity the self exciting or reacting principles. The lecturer exhibited one of Gramme's machines, and entered into a description of its principles. The Siemens' machine was almost identical with the Gramme. There might be mechanical differences, but practically it was the same. The Brush machine differed considerably from both. Instead of having a continuous soft-iron ring—a ring of wire was usually used—it had a large cast-iron ring with a number of transvere grooves cut into its surface. It had also a different form of connecting cylinder. But the main thing claimed as an advantage in the Brush machine was that there were two sets of brushes so arranged that this connecting cylinder alternately switched the current on to the magnets and to the external circuit, preventing the reversal of the polarity of the current which was sometimes considerable. There were some machines called alternating current machines. Without describing them very fully he would say that their day had gone by. They were the first machines made and were not suitable to naval or military requirements, because of the danger to life and limb. All the fatal accidents that had occurred since the introduction of the electric light were cases where alternating current machines were used. In both the accidents on the *Livadia* and at Aston Park, Birmingham, alternating current machines were used, and he was not aware that any accident whatever had occurred with continuous current machines.

(2). As to the transformation of the current into light, real improvement and progression had been made during the year. The early methods of using the lights was by means of lamps regulating the length of the electric arc. That was a complicated process, and an invention had been made which obviated its necessity altogether. Electric light depended upon no new principle. There was the undeniable electrical law that a current of electricity generated heat in the body through which it passed in precise proportion to its resistance. It would not be safe to attempt to give a definition of what resistance was; it was sufficient to note that of two bodies similar in substance the thicker offered less resistance to the passing of a current than the thinner body, and the body that offered the least resistance was the best conductor. A great deal depended on the material of the conductors; copper and silver were the best, and at the other end of the scale was carbon—an easily obtained substance. But if carbon could be employed it was what all inventors would work with; even Edison had at last fallen back upon it. By means of three slender filaments of carbon they were able to get a very splendid light; there was this difficulty—metals, such as platinum for instance, did not oxidise, but carbon itself, combining with the oxygen of the air would burn away, and the slender filament of carbon would be dissipated. It was that combustion that they had to prevent. They had now got so far as a lamp which was a combination of a filament of carbon with a protecting chamber, which might, of course, be of glass. The first step in this direction was made by Mr. Swan, of Newcastle. He, after working on this subject for sixteen years through good and evil report, had at last produced a lamp which, so far as we could see, was approximately perfect. It was excessively simple, consisting of nothing but a glass globe from which the air had been exhausted by a most perfect form of pump, which had been improved on by Mr. Swan and his *collaborateur*, Mr. Stern, of Birkenhead. Having got this vacuum he also made certain improvements in the method of connecting the carbon, and in the way in which the platinum wires inside were prevented from working loose and thereby admitting the leakage of air into the pump.

Mr. Crompton went on to describe the invention of Mr. Lane-Fox, who had attained, with Mr. Swan, similar results, but by a different process; he also described the André and the Reynier lamps, and the lamp specially devised by Mr. Swan for coal-mining purposes. This subject was never mentioned without Mr. Edison's name being brought into it. It was very unfair to other electricians, who had done so much work for many years, that their labours should be thought so little of, and that so much should be thought of Mr. Edison, who, in the opinion of those who knew most of the matter, had done nothing for the electric light. Mr. Edison was simply "got at" by a very powerful clique, told to invent something with the electric light, and directly he said he had invented something, the news was telegraphed to the proper quarters, and gas stock was dealt with: it was what was called an American Wall Street plant. He would not deny that Mr. Edison was an extremely clever

inventor, but it was a curious thing that he produced, as an original invention, a lamp similar to Mr. Swan's, and did not produce it until after Mr. Swan's lecture on the subject describing those lamps, two years ago. The lecturer went on to give a full description of the lamps which used the electric arc, illustrating his remarks by one of those lamps. The objection to that lamp was that as it was not a continuous current it required regulation. A hand-regulator had been invented for that purpose. He next gave an account of the electric candles, and passing on to the penetrating power of the light in fog, he showed that the only portion of the electric current which had power to penetrate fog was that coming from the bottom of the carbon—that part technically called the crater. He spoke of the uses to which the light had already been put for naval purposes, and pointed out several respects in which its utility might be increased; for instance, in the case of a large force requiring to be disembarked within a short space of time along a dark coast. Summarising the progress made during the year, he said that whereas the cost per hour was 1s. or 1s. 2d. per light per hour, they could now produce the same at 7d. or 8d. They had doubled the efficiency of the lamps, and had at the same time halved the price.

At the request of a gentleman, Mr. Crompton gave a long and interesting account of Professor Graham Bell's latest invention, the photophone, by means of which the human voice is transmitted to a distance through the agency solely of a beam of light.

In the discussion that ensued, Mr. Lane-Fox defended Mr. Edison against the disparaging remarks the lecturer had made.

Mr. Crompton was about to reply, when the chairman intimated that at that institution any matter of controversy was strictly excluded.

Several questions were asked and replied to by the lecturer, and the company separated.

TELEGRAPHIC APPARATUS IN USE IN THE BRITISH POSTAL TELEGRAPH DEPARTMENT.

XXVI.

THE WHEATSTONE AUTOMATIC SYSTEM.

(Continued.)

THE resistance to which the coils of the Wheatstone receivers are wound, in the latest instruments, is 200 ohms each coil, so that if they are coupled up in "series" the total resistance in circuit is 400 ohms. If they are coupled up for "quantity" the resistance is reduced to 100 ohms.

The coils are wound exactly in the same way as in the "standard relay" (Article V.), and "links" are provided, so that the coils can be coupled up either in "series" or "quantity."

It has been found that a high rate of speed is best obtained when the coils are coupled up for "quantity"; but in wet weather, when the leakage on the line is considerable, a low resistance does not enable sufficient magnetic effect to be generated to produce good signals: in this case, therefore, the "series" arrangement must be adopted although the speed of working is reduced thereby.

Some of the older forms of the instruments were wound to a resistance of 400 ohms each coil, or a total of 800 ohms in series. As this high resistance is found to be prejudicial to high speed, these coils have been joined up internally and permanently for quantity, as shown by fig. 105: thus the resistance of each coil is reduced to 100 ohms. When the terminals outside are joined up in "series," therefore, the coils are actually joined up for "quantity," the total resistance being 200 ohms. When the links are arranged for "quantity" the coils become joined up for "double quantity," giving a resistance of 50 ohms. Experiments seem to prove that the double quantity arrangement, with thin wire on the coils, gives a better effect as regards speed of working than does single quantity with thicker wire, although the combined resistances are similar in both cases.

It has been found that the mass of iron in the cores affects considerably the speed of working; hence the cores are considerably lighter in the most recent pattern of the instrument than in the older forms.

THE LOCAL CONNECTIONS.

Besides the "transmitter" and "receiver," every complete set of Wheatstone apparatus includes a galvanometer, a sounder, and a double current key, these latter being required for hand working, so that corrections, &c., can be given when necessary.

Connected to the hand lever shown at the left hand in fig. 90 (Article XXIV.) is a compound switch, by means of which the transmitter is switched out of circuit, and the double current key brought in in its place.

The arrangement of the switch, which is placed underneath the base of the transmitter, is shown by fig. 106. It consists of three insulated brass levers, A, B, and N, linked together by an ebonite bar, G, which latter is linked to the lever before referred to in fig. 90. When the latter lever is moved to the position in which it allows the clockwork of the transmitter to run, then the levers, A, B, and N, are in the position indicated in fig. 106.

By the help of fig. 88 (from Article XXIII.) we can trace out the connections. In this figure, for simplicity, the connections have been shown as if they were joined direct on to the various terminals, but actually they do so through the medium of the different pieces in the switch. The lettered arrowheads, ——➤, in fig. 106 show the connections which are actually joined on to the correspondingly lettered parts of the transmitter. The connections are, therefore, as follows:—The Copper of the battery is connected to the lever, A, from thence to contact-piece, *a*, and to the crank lever, C (fig. 88); similarly, the Zinc pole of the battery is connected to lever B, and from thence to contact-piece, *b*, which is itself connected to the crank-lever, Z (fig. 88).

If now the levers, A and B, be turned over to the right, which would take place if the clockwork of the transmitter were stopped, then the Copper pole of the battery will be connected through lever A and contact-piece *c*, with the C terminal of the double current key; similarly, the Zinc of the battery is connected through the lever, B, and contact-piece,

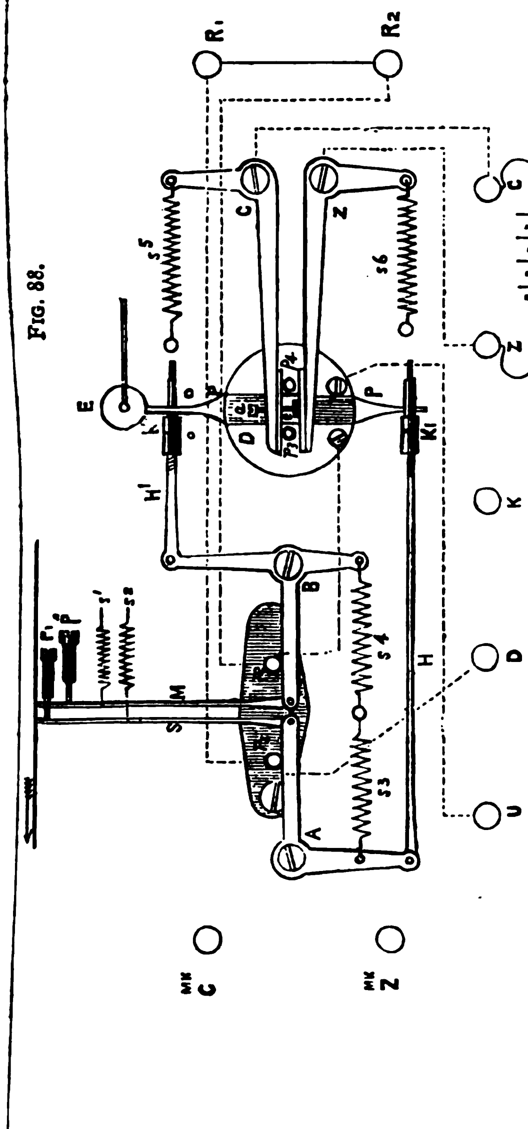
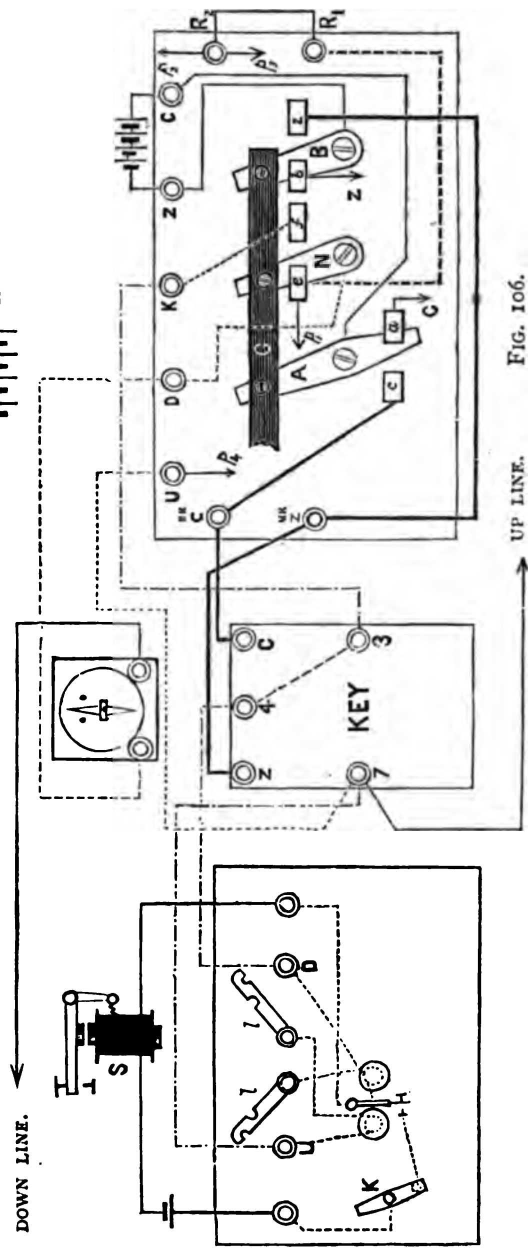


FIG. 88.



DOWN LINE.

UP LINE.

FIG. 106.

z, with the z terminal of the key, thus the battery is transferred from the transmitter to the double current key.

Supposing again, the levers, A, B, and N, to be in the position shown in the figure, then we have the "Down" line terminal, D, connected to the lever, N, and thence through contact-piece, *e*, with pin, p_1, of the rocking beam (fig. 88); the contact-piece, *e*, is also connected with terminal R_1.

If now the levers be moved over to the right, then terminal D becomes connected through lever N and contact-piece *f*, with terminal K, which latter terminal is connected to terminal 3 of the double current key; that is is to say, the "Down" Line becomes connected direct on to the key.

Besides the foregoing connections, we have terminal U conected internally direct on to the left-hand half of the disc, D (fig. 88), that is to say, on to pin p_4. Terminal R_2 is connected internally direct on to pin p_2 of the rocking beam and on to pin p_3 of the left-hand half of the disc, D (fig. 88).

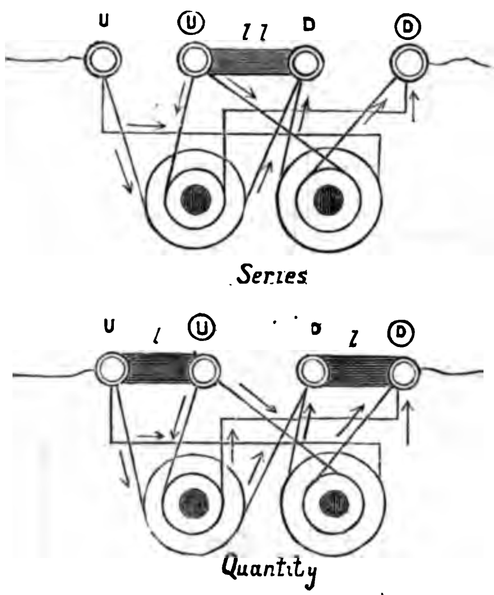


FIG. 105.

Externally, terminal U of the transmitter is connected to terminal 7 of the double current key; also terminals R_1 and R_2 are connected together by a brass strap.

We see then that levers A and B shift the battery from the transmitter to the double current key, whilst the lever, N, shifts the Down Line from the transmitter to the key.

The Up Line is connected to terminal 7 of the key, and to terminal U of the receiver, and also to terminal U of the transmitter.

In order to actuate the sounder, S, the lower tongue, F_1 (fig. 99, Article XXV.) of the electromagnet armature has a contact stop as in an ordinary relay; this contact stop is connected to the sounder, S (fig. 106), and a local battery in the manner shown. The lever, K, which is in the position shown in the figure when the clockwork of the receiver is stopped, on being moved breaks the local circuit, so that when the receiver is running the sounder ceases to act.

ERRATA on page 26 of No. CXCI. (Vol. IX.) dated January 15th, 1881, of THE TELEGRAPHIC JOURNAL, "Resistance of Dew on the Surfaces of Insulators:"—Opposite 10th, 12·0; 11th, 12·20; 12th, 14·20, and 15th, 11·20, read ∞ (sign for "infinity,") in columns headed "resistance"; and for "true contacts" read "tree contacts."

Notes.

WE have been requested to state that the initials of the inventor of the Fire Alarm Apparatus, described in our issue for January 15th, were misprinted. The name should have been S. M. Banker.

THE lecture at the Royal Institution, on Friday evening, January 21st, was delivered by Mr. Warren de la Rue, F.R.S., on "The Phenomena of the Electric Discharge with 14,400 Chloride of Silver Cells."

THE spring course of lectures and laboratory instruction in connection with the City and Guilds of London Institute will be held during January, February, March, and April of the present year, commencing January 24th. Professor Ayrton will conduct the course on "Electrical Instrument Making," "The Electric Light," "Motor Machinery," and "Junior Electricity and Magnetism."

M. JAMIN has been elected Vice-President for 1881 of the French Academy of Sciences.

THE Municipal Council of Paris has given authority to the Lontin Company to light the Place du Carrousel with electricity. A contract has been signed by the Lyons and Mediterranean Company for illuminating, by the Lontin light, all the principal railway stations on their system. Experiments have been tried at Marseilles and have been carried out successfully.

M. DUNAND, in a paper presented before the Academy of Sciences, has shown that if a microphone be placed in circuit with the primary wire of an induction coil, and the secondary be joined in circuit with a battery and a Varley's condenser, that speech is reproduced in the latter from the microphone. This effect is not produced unless a battery is in the secondary circuit.

ARRANGEMENTS have been completed with the British Electric Light Company for the experimental lighting of certain important parts of the General Post Office, St. Martin's-le-Grand. The first series of experiments will be conducted in the Telegraph Instrument Galleries.

MR. ALFRED R. BENNETT, M.S.T.E., late Engineering Superintendent to the United Telephone Company, has been appointed engineer and manager of Messrs. D. and G. Graham's telegraphic and telephonic system, which extends over the whole of Glasgow and for thirty miles

around, and is said to be on the eve of considerable development.

A PATENT has been taken out in America by Mr. E. Berliner, for a photophonic transmitter in which use is made of a heat-flame of low luminous quality—as, for instance, the flame of a Bunsen burner, or of an oxyhydrogen light, which is hardly visible, but which may heat other substances brought into its reach to incandescence, so that they become luminous, and to an extent as they are brought into contact with the flame. A pencil of platinum, calcium, asbestos, or similar refractory substance is arranged so that its point is just in contact with the flame, and this pencil is vibrated by means of a diaphragm to which it is secured, or by which it may be acted upon. By this means more or less of the pencil is brought in contact with the flame, and the light emitted by the pencil will therefore in strength be proportionate to the amplitude of each vibration, and light-waves, varying in intensity and number in proportion to the transmitted sound-waves and their intensity, will result from this manipulation. The idea does not seem a very happy one.

IN his annual message to Congress the President suggests the consideration of the necessity of extending Government aid to a Pacific telegraph cable. He says:—In this connection I desire also to suggest the very great service which might be expected in enlarging and facilitating our commerce on the Pacific Ocean, were a transmarine cable laid from San Francisco to the Sandwich Islands, and thence to Japan at the north and Australia at the south. The great influence of such means of communication on these routes of navigation, in developing and securing the due share of our Pacific coast in the commerce of the world, needs no illustration or enforcement. It may be that such an enterprise useful and in the end profitable as it would prove to private investment, may need to be accelerated by prudent legislation by Congress in its aid, and I submit the matter to your careful consideration.

A NEW electric lamp has been brought out in Paris; it is a combination of the Werdermann with a perforated carbon filled by an insulating medium. It is said to work well.

THE U.S. Consul-General at Shanghai, China, informs the State Department at Washington that the Emperor of China has given permission for the construction of a telegraph line from Shanghai to Tientsin, a distance of 1,200 miles. The route will be from Shanghai to Chinkiang, thence along the line of the Grand Canal to Tientsin. A short line of about 70 miles will also probably be constructed by the Viceroy at Nankin to connect the capital of his province with the main one at Chinkiang. The work of setting the poles and laying the wire will be begun early next spring. It is estimated that the work will cost 500,000 dols.

ON Monday, December 20th, the first trial of electric street lighting in New York was made. The territory selected was the portion of Broadway between Fourteenth and Twenty-ninth streets, three-quarters of a mile in extent, and was traversed by 10,000 feet of wire. The generators are run by a Corliss engine of 125 horse-power. On Monday night, 14 horse-power was used. Another engine is to be put in the station, and ultimately 500 horse-power will be generated there. Wires have been laid to Thirty-fourth street, and the current will be sent through them at an early day. It is said that the company expects to light for a mile east and west from the Twenty-fifth street station. Meanwhile, further trials are making to furnish data as to cost and the distance apart at which the lights should be placed, preparatory to an invitation to the Brush Company by the city officials to send in a bid for lighting a square mile of territory.

ON Wednesday, the 12th inst., Falmouth was put in direct telegraphic communication with Bilbao and Madrid by means of the cables of the Direct Spanish Telegraph Company. Congratulatory messages were exchanged between the Mayor of Falmouth and the Alcalde of Bilbao. The work of laying the cables underground between the Lizard and Falmouth has been conducted by Mr. J. Jeffery, A.S.T.E., assisted by Mr. R. Balkwill, and has been very successful throughout. The *pièce de resistance* in the construction of the land line was laying the cables across the arm of the sea at Helford, and the limited means at the disposal of the superintending officer of works enhanced the difficulty. A hawser was laid across the river, and by this means a barge belonging to the Gweek Company, laden with cable, was hauled across the river, paying out cable as it proceeded. One knot of this cable weighs 16 tons. The offices of the company are in the Post Office buildings, on the first floor.—*Falmouth Advertiser.*

WE have received from Messrs. Ransomes, Head & Jefferies, of Ipswich, a catalogue of engines manufactured by them for driving electric light machinery. This, we believe, is the first catalogue of the kind yet issued. Several of the engines are fitted with the dynamo machines on to their frames, and are very compact, whilst all the forms seem well suited for the purpose intended. Automatic governors are fitted, whereby great uniformity of speed is obtained.

M. CLAMOND, well known in connection with thermo-electric generators, has taken out a patent for the production of an intense white light. This is produced by heating air that is supplied to a gas flame, and projecting the latter on to a cylinder of lime.

IN a note to the Vienna Academy (*Anz.* December 16) Prof. Stefan describes experiments on the influence of terrestrial induction in development of an electric current, and the excitement of the telephone by currents from a rotating coil. The coil used was 56 mm. in external diameter, and 11 mm. in width. The earth's influence is best shown by so connecting the apparatus with a galvanometer that the circuit is closed during one half of the coil's rotation, and broken during the other half; if the completion of the circuit correspond to the positive maximum of the electromotive force of the earth's magnetism, and the interruption to the negative, the galvanometer is positively deflected. The deflection may be reduced to zero by displacing the contact, and from the displacement and the number of rotations the potential may be inferred in absolute measure. Next the telephone was so connected with the coil that the full alternately opposite currents went uninterruptedly through the circuit. This gave a simple tone. With 100 rotations per second the horizontal component of the earth's magnetism did not suffice to excite an ordinary telephone, but it excited one having a horse-shoe magnet. (When the intensity of the field was doubled the ordinary telephone was also excited.) The tone corresponds to the number of rotations. When the coil was rotated 220 times in a second the ordinary telephone sounded. The telephone was shown to be less sensitive to currents whose intensity periodi-

cally changes than to interrupted currents (an ordinary telephone sounded with 100 rotations or fewer, when the circuit was closed only during a short time of each rotation).—*Nature.*

IN the issue of *Nature* for January 20th Lord Rayleigh gives a mathematical investigation of the impact of intermittent radiation upon thin plates of various substances, in which he proves that the phenomena observed in the photophone are explicable upon the assumption that there is a periodic communication and abstraction of *heat* upon the diaphragm.

THEORY OF THE GALVANIC ELEMENT.—Prof. Fr. Exner. — An electro-separative force exists neither between the metals and the liquids nor in the metals among themselves, except in the cases where a chemical reaction is manifested. The total action of a galvanic element is exclusively derived from the chemical action which takes place in its interior. The formulæ expressing the free tensions of an open element, in as far as they proceed from this point of view, are in perfect harmony with the results of experience. It is the same with the tensions of a closed element. The author has traced, in accordance with these observations, diagrams of the potential levels of the chief galvanic elements.—*Academy of Sciences of Vienna.*

A CONTRIBUTION TO THE THEORY OF CONSTANT GALVANIC ELEMENTS.—N. Slouguinoff.—The author calculates the electromotive force of n elements connected together and of different electromotive power, as also the electromotive force of elements in which polarisation is manifested, and deduces hence the well-known electromotive law.—*Wiedemann's Beiblätter.*

COMBINED HOLTZ AND TÖPLER'S SELF-EXCITING INFLUENCE MACHINE.—R.Voss.—The author describes a machine of the form of that of Holtz, which can be converted into a self-exciting Töpler's machine by the introduction of other discs. The fixed disc has two paper coatings of the ordinary form and four tin-foil coatings, connected two and two, the latter being connected with two pieces of brass fitted with metal bows and metal brushes. The rotatory disc has six tin-foil coatings with metal projections which rub against the metal bows with their brushes. The double absorber has also two metal brushes which rub against the brass projections. The machine is said to be capable of acting in all conditions of the atmosphere provided the metal brushes touch the brass projections and not the glass. As regards quantity, the machine yields as much electricity as that of Holtz, but the length of the sparks is less by a couple of centimetres, since the electricity does not reach as high a tension as in the Holtz machine.—*Dingler's Journal*, 237, p. 476.

ON THE INFLUENCE OF CONCENTRATION UPON THE ELECTROMOTIVE FORCE OF A DANIELL'S ELEMENT.—J. V. Hepperger.—The electromotive powers of two Daniell's elements with sulphate of zinc solutions of different degrees of concentration, as calculated from the strength of the currents and the resistances, differ from each other as much as the powers of amalgamated zinc plates with the same solutions. The electromotive force of solutions of zinc and copper sulphates of different degrees of concentration was examined by means of the hair-electrometer. If we call the electromotive power of a 1 per cent. solution E, then :—

Solution......	1	5	10	15	20	25	30	40
Zinc sulphate..	E	—	11	—	18	—	21	25
Copper sulphate	E	13	18	21	24	26	27	

$\frac{1}{1000}$ D is taken as unity. The current passes from the more dilute to the more concentrated solution. Between mercury electrodes the electromotive force of a 10 and a 50 per cent. solution of sulphate of zinc is respectively as — 20 and 0. The law of the series of tension naturally holds good here.

THE UNITED TELEPHONE COMPANY (LIMITED.)—The meeting of this Company adjourned, as stated in our last issue, from the 13th ult., was held on Thursday last, the 27th ult., to consider an agreement with a company yet to be formed, and to be called the Provincial Telephone company (Limited.) Mr. Brand, the chairman, having proposed a resolution as to its adoption, and the same having been seconded, after some discussion, was declared duly carried.

ON the 22nd ult. a heavy sleet storm raged on the North Atlantic seaboard. Many telegraph wires were broken, and the poles thrown down, causing great obstruction to business. Not a single telegraph wire from New York city could be worked.

THE Scottish Telephonic Exchange Company, Limited, has, in answer to an application, received from the Postmaster-General a form of proposed license which contains very onerous restrictions as to the details of working, and indicates a high scale of royalties. The company is negotiating with a view to obtain some modifications.

GLASGOW TELEPHONIC EXTENSION.—It is stated that Messrs. D. and G. Graham have received information from the Post Office authorities that their application for a license to carry on their telephonic system will be granted. This firm, prior to the case being taken against the Edison Telephone Company by the Government, had contracted with the proprietors of the Gower-Bell Telephone for the exclusive use of their instrument within a circuit of 30 miles round Glasgow. A large number of lines have already been laid for stock-brokers, shipbuilders, shipowners, and other establishments. The firm intend to open very shortly a Central City Telephonic Exchange in St. Vincent's Place, within two minutes' walk of the Exchange.

GLASGOW PHILOSOPHICAL SOCIETY.—At a meeting of the Glasgow Philosophical Society, held on the 19th January, Mr. A. Jamieson, C.E., principal of Glasgow Mechanics' Institution, read a paper on "The History of Selenium and its action in Professor Graham Bell's Photophone." After referring to the history of selenium and the results of experiments with it, he explained a simple cell which he had designed, and showed how sensitive it was to light by diagrams and apparatus in the form of a Wheatstone's bridge with Sir Wm. Thomson's reflecting galvanometer. He had tried the effect of singing gas flame, and found, to his surprise, that the tone was clearly reproduced by his sensitive selenium cell and a telephone. By one person speaking behind a sensitive membrane stretched across a gas-holder with a burner in front, the gas vibrated in perfect unison with the voice; the selenium cell rose and fell in resistance and governed the battery current, which effected in the telephone the exact song or words, and which were clearly audible at the end of a telephone joined in circuit at 200 feet distance. Sir Wm. Thomson, in moving a vote of thanks, said that Mr. Jamieson's experiments had added materially to the knowledge on the subject.

THE GOWER TELEPHONE.—We understand that the Indian Government Telegraph Department, which some time since refused to sanction the setting up of Telephonic Exchanges, has now decided itself to supply the Indian public with telephonic intercommunication. After having experimented with a first supply of about thirty of the Gower-Bell Company's loud-speaking instruments, an order has been placed with that Company for some hundreds of them.

Correspondence.

IOUR'S BALANCE GALVANOMETER.

e Editor of THE TELEGRAPHIC JOURNAL.

IR,—I notice in the article on my galvanometer, in speaking of the different values of the in measuring current strength from the battery d through the patient—the article states, "it rom $\frac{1}{100}$ of a grain to ·75 to 1;" it should be $\frac{1}{10}$ of a grain to about 2·5 or 3 grains.

Yours faithfully,
P. W. SEYMOUR.

Proceedings of Societies.

OCIETY OF TELEGRAPH ENGINEERS.

t ordinary general meeting of this Society for on commencing January, 1881, was held on inst.

nair at the opening of the meeting was taken V. H. PREECE. The minutes of the previous having been read and confirmed, Mr. W. H. ntroduced the new President, PROFESSOR G. OSTER, F.R.S. A vote of thanks having been l to the retiring president by SIR CHARLES and seconded by PROFESSOR W. G. ADAMS, r Foster took the chair, and read his inaugural as follows:—

sor Foster commenced by saying it was difficult to assign any reason for the choice of himself ew president of the Society, he could only attri- o disinterested kindness, or to the desire of the to be considered scientific as well as practical.

e 21st July, 1821, Oersted made his discovery ffect of the galvanic current upon the magnetic Twelve months after he discovered the recip- tion of currents on magnets and on each other. ollowed up the results, and subsequently Sir rey Davy made his well-known experiment of tric light with 2,000 battery cells, at the Royal ion.

31 Faraday made the discovery of induced cur- hich has led to the most important scientific and l results. The reciprocity of electricity and lynamic action was thus shown. Ampère's ex- ts showed the same facts in different aspects, ermined certain laws. The discovery of these ve two aspects to the phenomena, otherwise it ave simply been a discovery of natural history, ld have led to very little result. The discovery nduced current was one of the very greatest im- e, as the practical applications of the present ve, such as the electric light, electro-motors, the ne, &c. Faraday's discovery laid the foundation hese inventions.

e practical results benefit science to a very great If a new instrument is invented for practical laws affecting it become investigated. The use electric telegraph has led to an investigation of urrents.

n operations are transferred from the workshop aboratory the object is changed, as then it is to the laws of the question and not to obtain a al result that is aimed at; the criterion of success rent in the two cases. In both cases the import- s the same—in one case the aspect is quali- nd in the other quantitative. Until phenomena luced to mathematical laws their value can- estimated, since to make the phenomena of commercial value every effect must be understood. Thus the number of electrical machines which have been made within the last 100 years have been legion, but no distinct laws have been laid down as to its operation, whereas in the case of the galvanic battery, which has proved of so much practical value, the laws governing its action are well understood.

The progress made in the last 30 years in electrical science has amounted almost to a complete transforma- tion, and all the facts learnt are now reduced to a clear basis.

One of the greatest aids in bringing about the progress has been the establishment of *standards*, which has enabled the doctrine of energy to be put on a firm footing. Arbitrary standards have merely reference to some fixed element of its own kind. Absolute standards have reference to the elements of time, space, and mass. It is the adoption of these standards which distinguishes the present from the past. It is necessary that a clear conception of the thing to be measured be gained, but this grows up in the course of time.

The first step towards the fixing of standards was made when Ohm enunciated his well-known law. Gauss in 1832 showed how an absolute measure could be obtained of the intensity of the earth's magnetism. In 1840 Weber showed how this could be applied to electric currents. Biot and Savart showed how Oersted's discovery could be expressed in the same way. Later Weber pointed out how a circular conductor when rotated could generate a definite current whose dimen- sions could be thus obtained in absolute measure; he further calculated the electro-chemical value of the current, showing how many grammes of water could be decomposed in a given time by a given amount of current.

In 1851 Weber published a complete theory, showing how the earth's magnetic intensity could be related to the dimensions of the electric current, and how the elements of length and time were involved. Ohm's law enabled this to be done, as all the terms are interchangeable. Two elements being known, the third can always be determined. Weber actually formed material standards and deposited them in the museum at Leipzic, the dimensions being 10, 5, and ½ ohms.

Sir William Thomson fully appreciated and adopted Weber's reasoning, and he showed how the motion of a conductor through a magnetic field could be expressed in thermal and chemical units. He thus determined the value of the volt at 1·07 of a Daniell cell. The result depended upon energy only.

In 1856 Bosscha determined the value of the volt at 1·026 of a Daniell cell, and in 1858 the result was given as 1·09.

Since the value of the unit of resistance was deter- mined, Mr. Latimer-Clark and Kohlrausch also deter- mined the value of the Daniell cell.

About 1861 the necessity for expressing the measure- ments used in connection with the testing of submarine cables in standards was strongly felt, and in 1861, at the Manchester meeting of the British Association, a com- mittee was appointed, who undertook the work of forming material standards, a grant of £50 being given for the purpose. The experiments lasted till 1870, during which time the sum of £590 had been granted. The advantage of the standards was abundantly re- cognised.

The value of the standard unit, as calculated by different workers, differed considerably, as under:—

1870	Kohlrausch	1·0196
1873	Lorenz	·9717
1876	Rowland	·9912
1877	Weber	1·002

It is very important that the time value be determined.

The experimental methods adopted depended upon induced currents with one exception, in which the measurement was made by the heat developed in a wire.

In Lorenz's method a steady current was employed by rotating a copper disc, this method is only mentioned as being a simple method, and accuracy is not claimed.

Dr. Schuster has been experimenting at the Cavendish Laboratory, Cambridge, with the original instruments, and further experiments are to be made with a new apparatus.

Considerable doubts having existed as to the permanence of the existing standards, experiments were made in 1867 by Dr. Crystal on the standards originally formed; these appeared to be quite correct and unchanged, with the exception of the platinum-iridium standard, which had gone down slightly. Dr. Fleming, who had made some experiments on the temperature coefficients, found five of the standards right and two different from the rest, but all agreed within $\frac{1}{1000}$th of each other.

Amongst the various methods of testing, two are capable of various applications as showing pure and applied science, viz., the Wheatstone bridge and Poggendorff's method of determining the relative electro-motive forces of batteries. Thomson's condenser method on the principle of the bridge was also to be enumerated, as well as Mann's method of determining the resistance of batteries. The condenser method had a practical application in the duplex telegraph system. Poggendorff's method gave rise to the "Potentiometer" of Mr. Latimer-Clark, and the latter instrument was useful for determining the absolute value of currents.

Sir Charles Bright's and Mr. Latimer-Clark's division of the units into decimal multiples has proved of great value, and the use of the *dyne* and the *erg* was suggested by the ohm and the volt.

In concluding his address, Professor Foster said that he would suggest that until the dimensions of the electrical units were settled beyond dispute, the Society of Telegraph Engineers and Electricians should become the depository of the standards for general use, and should issue certificates of the value of resistances submitted to them, as was done at the Kew Observatory with other standards.

At the conclusion of the address, a vote of thanks was proposed by Mr. Edward Graves, who said that it was a great point that the addresses of the presidents were always of a varied character. Great points of importance were brought forward by Professor Foster. His address was a *résumé* of scientific discoveries of a qualitative character which pointed to the necessity for exact calculation.

He begged to move that the address be printed in the Journal of the Society.

Professor Hughes seconded the motion, which was carried unanimously.

A paper was then read by Mr. A. W. Heaviside on "Telephonic Induction," in which the results of some experiments were given. It was pointed out that induction could be heard in a telephone held near a working circuit with no wires attached to the former. When the terminals of the telephone were short-circuited this effect entirely disappeared.

After some remarks by Professor Hughes, Mr. Stroh, and Mr. A. J. S. Adams, the meeting adjourned.

PHYSICAL SOCIETY.—Jan. 22.

Professor W. G. Adams in the Chair.

New member—Mr. G. Palgrave Simpson, B.Sc.

"Notes on the Construction of the Photophone," by Professor Sylvanus Thompson, were read by Professor Rheinold. Professor Thompson was led by experiment to question whether Professor Bell's form of photophone receiver was adapted to give the best results. Theoretically, he finds, with a given maximum of incident light distributed uniformly over the surface, the change of resistance in a selenium receiver will vary proportionally with its linear dimensions, provided its parts be arranged so that, on whatever scale constructed, the normal resistance shall remain the same. A cell, n times greater linearly each way, will produce n times the variation in resistance for the same total amount of light. This follows, from Professor W. G. Adams' law, that the change in the resistance of selenium is directly as the square root of the illuminating power. The author also finds that if the thickness of the conducting discs in the enlarged cell be kept the same as before, and their number increased n times, the change of resistance will be n^2 times as great as before. Selenium cells should therefore be as large as possible, and the light should be distributed over them uniformly, not focussed to a point. A conical mirror would, therefore, be better than a parabolic one to receive the beam. Such a reflector would be cheaper to construct, and there would be a minimum of loss by reflection, as the light would fall perpendicularly on a cylindrical cell parallel to its axis. To give the best effect its angular semi-aperture should be 45°, and this will bring the front end of the cell in the same plane as the mouth of the reflector. Professor Thompson has also constructed an improved cell by winding parallel wires on a cylinder of slate grooved with a double-threaded screw and filling the interval between them with selenium. This form gives superior effects to Professor Bell's disc devices.

Mr. Shelford Bidwell said that long annealing improved the sensitiveness of selenium for photophonic purposes. He got the best speech from cells of high total resistance made with fine wire. The selenium should, however, have a low specific resistance. With the apparatus he showed at a recent meeting of the Society he could now transmit articles from *Nature* and the *Nineteenth Century* so that every word could be heard by the listener.

Professor Guthrie suggested that amorphous phosphorus should be tried in place of selenium, as a more permanent substance.

Mr. Glazebrook, of the Cavendish Laboratory, Cambridge, read a paper on the measurement of small resistances, and the comparison of the capacities of two condensers. In measuring small resistances by the Wheatstone balance the results differed on varying the resistance in the battery wires. According to Professor Crystal, this was due to a thermo-electric effect produced at the middle point of the divided platinum-iridium wire when the contact is made with it. It could be avoided by making this contact first, and then making the battery contact. Mr. Glazebrook investigated the effect mathematically and experimentally. He suggested that the resistance in the battery wire should be kept small in comparison with the other resistances, and then the effect was inappreciable. It could also be eliminated by taking two measurements with reversed currents and calculating out. The author next considered the effect of a small leakage in comparing condensers by the Wheatstone balance method.

Dr. Hopkinson stated that he had found a modification of this plan to be very promising. For the battery

he uses an induction coil, and for the galvanometer a telephone. Thus a high electromotive force and sensibility was obtained.

New Patents—1881.

39. "Improvements in street curbs and gutters intended for the reception of telegraph wires." H. J. Haddan. (Communicated by J. D. Townsend.) *Complete.* Dated January 4.

48. "Apparatus for generating and utilising electricity for lighting and other purposes." W. R. Lake. (Communicated by E. Etève.) Dated January 4.

56. "Mechanical telegraphs." W. Chadburn. Dated January 5.

65. "Electric lighting." J. M. Justice. (Communicated by H. C. Spalding.) Dated January 6.

78. "Dynamo-electric machines for electric lighting." J. E. H. Gordon. Dated January 6.

93. "Telephonic apparatus and conductors." J. Imray. (Communicated by C. Herz.) Dated January 8.

108. "Improved apparatus for and means of converting heat into electricity." J. C. Ramsden. Dated January 8.

129. "Improvements in galvanic polarisation batteries, or magazines of electricity, and the application of the same, and in apparatus connected therewith." J. H. Johnson. Dated January 11.

152. "Electric batteries." J. A. Lund. Dated January 12.

153. "Electric lamps." A. Muirhead and J. Hopkinson. Dated January 12.

200. "Transforming, conveying, and applying power by means of electricity, and apparatus for that purpose." J. Imray. (Communicated by J. E. Cavanellas.) Dated January 15.

218. "Apparatus for producing electric light." J. E. H. Gordon. Dated January 17.

225. "Improvements in electric lamps, in the manufacture of parts thereof, and means of turning on and off electric currents for lighting and extinguishing lamps for other purposes." St.-G. L. Fox. Dated January 18.

229. "Improvements in the process of restoring waste vulcanised india-rubber or gutta-percha, and in compounds produced thereby; which invention also comprises improvements in telegraphic or telephonic wires coated and covered with such compounds or other materials." H. H. Lake. (Communicated by H. A. Clark.) *Complete.* Dated January 18.

245. "Improvements in the construction of apparatus for lighting gas, which improvements are also applicable to other electrical appliances." C. L. Clark and J. Leigh. Dated January 20.

253. "Improvements in apparatus for producing electric currents and applying them for illumination, and for the transmission of power, as for example, for the steering of ships." C. G. Gumpel. Dated January 20.

264. "Certain improvements in apparatus for measuring, generating, and using electric currents." A. Apps. Dated January 21.

275. "Electric semaphores for railway purposes." W. R. Lake. (Communicated by F. R. F. Brown.) *Complete.* Dated January 21.

286. "Telephones." F. H. F. Engel. (Communicated by J. H. Königsleib.) Dated January 22.

288. "Improved method of and appliances for controlling and regulating the speed of engines employed for driving dynamo-electric machines." J. Richardson. Dated January 22.

304. "Improvements in the manufacture of carbon and graphite, which invention also comprises the formation of these materials into rods, bars, pencils, and other articles and apparatus therefor." R. Werdermann. Dated January 22.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1880.

1826. "Apparatus for producing electric light." James Edward Henry Gordon. Dated May 4th. Describes the lamp illustrated in the number of the Telegraphic Journal for Dec. 1st, 1880.

1907. "Railway signal apparatus." William Robert Sykes. Dated May 10th. 6d. Has reference to improved mechanical and electrical arrangements for carrying out a combined lock and block system of signalling or working signals.

2183. "Railway signalling apparatus." Charles Ernesto Spagnoletti. Dated May 28th. 6d. This invention has for its object improvements in controlling and working trains on railways by locking signals, and interlocking them with the block telegraph system by electrical and mechanical means, the trains in their course assisting in the completion of the system. (*See* page 43.)

2354. "Batteries for the transmission of sound." Robert Henelade Courtenay. Dated June 10th. 2d. Has for its object the construction of either a single cell or a series of batteries in such a way as to form either a single or compound transmitter of sound by means of a tension spring adjusted to the negative element of the battery. (*Provisional only.*)

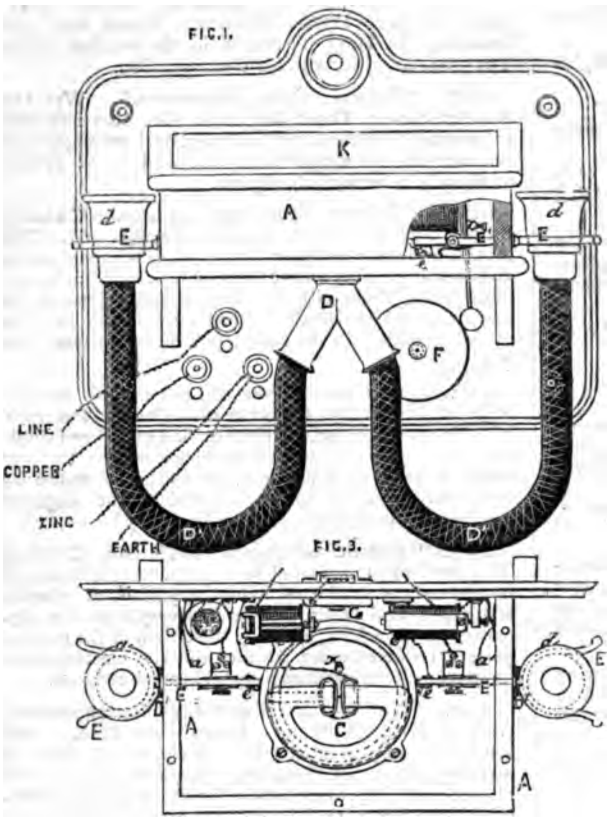
2387. "Electric telegraphs, &c." Sir Charles Tilston Bright. Dated June 12th. 6d. Consists of improvements in the receiving apparatus of electric telegraphs and other instruments employed for signalling by electricity, whereby the action of the moving parts is rendered more distinct and the electromotive force requisite to produce a signal is much reduced.

2390. "Working of railway signalling apparatus." George Kift Winter. Dated June 12th. 10d. Relates to improvements in and connected with the working of railway signalling apparatus, has especial reference to improvements in block telegraph instruments which require the combined action of the signalmen at the ends of a section in order that the indications of the instruments may be varied, so that no signal is complete until it has been acknowledged, the combined action of the signal itself and its acknowledgment being required to cause the instrument to indicate the signal that has passed, and in which the state of the line is clearly indicated, not only as to whether there is a train on the section or not, but also the direction in which a train is travelling over the section; and a modification of which allows of either signalman causing both instruments to indicate "train on line," *i.e.,* the "danger" signal, but requires the combined action of both signalmen to remove the "danger" signal and cause the instruments to indicate "line clear." The invention also has reference to the connection of a

starting-semaphore with the block instruments and with an attachment to the permanent-way in such a manner as that it is put to "danger" by the passage of a train into the block section between such instruments, and can only be lowered by the combined action of the signalmen at the ends of that section.

2453. "Electric apparatus for working railway brakes." John Clayton Mewburn. (A communication from abroad by Ferdinand Auguste Achard, of Paris.) Dated June 17th. 6d. Relates to electric apparatus for working railway brakes, and more particularly to improvements in the apparatus described in the Telegraphic Journal for August 15th, 1878.

2610. "Telephones. John Henry Johnson. (A communication from abroad from F. A. Gower of Paris.) Dated June 26th. 6d. Relates to the combination of what is known as the Gower telephone with a microphone enclosed in the same case. Fig. 1 is a front elevation of the improved apparatus, a part of the front of the box being removed in order to show the position of the commutator. In this figure it will be observed that the commutator is not in contact with the binding post. Fig. 2 is a side elevation of the apparatus, partly in section, a portion of the side of the box being removed in order to show the communication between the microphone and the principal circuit. Fig. 3 is a plan, the microphone being removed in order to show clearly the arrangement of all the parts on the interior of the box. Fig. 4 is a plan of the underside of the microphone shown in fig. 2. This microphone is connected with the principal circuit by means of wires, a, a^1, which are broken off in figs. 3 and 4. When the plate of the microphone is in the position shown in fig. 2 so as to close the box, the wire, a, fig. 4, is joined to the wire, a, fig. 3, and the wire, a^1, fig. 4, is joined to the wire, a^1, fig. 3. A microphone, B, of any suitable construction (but by preference having at least six contact points, b) is attached to the upper part, K, of a box, A, the lower part of which box is provided with a Gower telephone, C, constructed in the form known as the chronometer telephone. This telephone is provided with a bifurcated acoustic or speaking tube, D, having two branches, D^1, in order to enable the operator to listen with both ears if required. Commutators E are provided at the side of the box for the purpose of interrupting the passage of the current from the battery and opening the circuit of the call bells. After working the apparatus the extremities, d, of the acoustic tubes, D, D^1, are placed in holders connected with the commutators, E, and the circuit is thereby interrupted, as shown in fig. 1, in which figure the commutator, E, is shown out of contact with the binding post, e. An electric call bell, F, is provided underneath the box, A, and a knob, G, for working the call bells is placed at the upper part of the apparatus. An induction coil, H, is placed inside the box, and the microphone, B, and the battery are connected to the



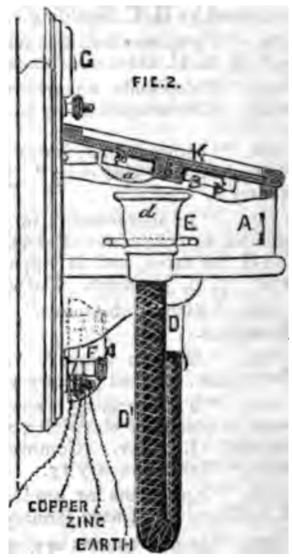
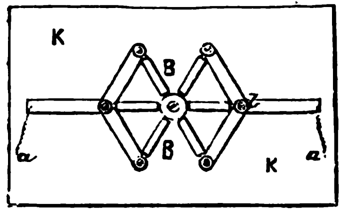


FIG. 4.



primary circuit, whilst the Gower telephone and the line are connected with the secondary circuit.

Claims.—1st. The combination with a magnetic telephone of a microphone, the two instruments forming constituent parts of one and the same apparatus, substantially as hereinbefore described and illustrated in the accompanying drawings. 2nd. The employment in the said combination of a flexible double tube for speaking and listening, substantially as hereinbefore described and illustrated in the accompanying drawings.

City Notes.

Old Broad Street, January 28th, 1881.

THE ANGLO-AMERICAN TELEGRAPH COMPANY, LIMITED. —An extraordinary meeting of the members of this Company was held on the 14th inst. at the City Terminus Hotel, Cannon Street, "to consider and, if so determined, to confirm and adopt certain agreements made between this Company, the Direct United States Cable Company, Limited, and La Compagnie Française du Télégraphe de Paris à New York, with respect to the working of the lines of the said Companies, and division and appropriation of the traffic receipts." By these agreements, which it was proposed to ratify, the traffic receipts of the three Companies would become divisible in the following proportions:—63 per cent. to this Company, 21 per cent. to the Direct United States Cable Company, and 16 per cent. to the French Company, with certain modifications in the event of interruption of the respective cables. The resolution approving of the agreements having been moved by the chairman, Viscount Monck, and seconded by Sir D. Gooch, M.P., was, after some discussion, put to the meeting, and was carried with two dissentients.

DIRECT UNITED STATES CABLE COMPANY, LIMITED. —An extraordinary general meeting of this Company was held on the 14th inst. at the City Terminus Hotel, "to consider, and if approved, to confirm and adopt certain agreements made between the Anglo-American Telegraph Company, Limited, the direct United States Cable Company, Limited, and La Compagnie Française du Télégraphe de Paris à New York, with respect to the working of the lines of the said Companies, and the division and appropriation of the traffic receipts." Mr. W. Ford presided, in the absence of Mr. Pender, M.P., through the death by scarlet fever of his second son. The solicitor of the Company read the agreements, four in number. By these agreements, taken in connection with the existing agreements between the Anglo-American Telegraph Company and this Company, the joint receipts of the three Companies will become divisible in the following proportions:—63 per cent. to the Anglo Company, 21 per cent. to the Direct Company, and 16 per cent. to the French Company, with certain modifications in the event of interruption of their respective cables. The chairman, after some remarks, concluded by moving a resolution to carry out the objects of the meeting. Mr. Underdown seconded the motion, which, after a short discussion, and a reply from the chairman, was carried unanimously. A vote of thanks to the chairman, and of sympathy with Mr. Pender in his bereavement, closed the proceedings.

The Board of this Company have resolved upon the payment of an interim dividend of 5s. per share, being at the rate of 5 per cent. per annum for the quarter ended 31st December, 1880, such dividend to be payable on and after the 16th February next.

THE CUBA SUBMARINE TELEGRAPH COMPANY, LIMITED.—At the nineteenth ordinary general meeting of this Company, held on the 19th inst., the chairman, Mr. T. Hughes, in moving the adoption of the report and accounts (see THE TELEGRAPHIC JOURNAL of January 15th), said the shareholders would, of course, have seen, with the same regret as the board, that the past half-year had been one of the worst, if not the worst, that the Company had experienced in the ten years of its existence, and from the documents which had been submitted to them they would have no difficulty in accounting for this state of things. They would have seen that practically during the greater part of the year the majority of the sections of the West India and Panama Company's lines had not been working, and they were the best feeders of this Company, and the source upon which they almost relied for their traffic. When such a condition of things as that prevailed, the result must be prejudicial to the Company. He was happy to say, however, that towards the end of the year, by the exertions of the West India and Panama Company, their lines, with two exceptions, were now in working order, the result being at once apparent, because their private advices showed that the traffic was already to a considerable extent righting itself. He regretted, however, to say that the two sections which remained to be repaired of the West India Company's system were two of the most important, namely, the Demerara section and the Colon section, through the latter of which the traffic from the isthmus came to Europe. This section was of increasing importance at the present time, on account of the expedition which M. Lesseps was just about to despatch to the isthmus. After some further remarks the motion was seconded and carried unanimously.

The chairman then moved the payment on the 20th inst. of dividends at the rate of 5 per cent. per annum on the ordinary shares and at the rate of 10 per cent. per annum on the preference shares; this having been seconded was unanimously carried. The meeting then closed with the usual vote of thanks.

THE EASTERN TELEGRAPH COMPANY, LIMITED.—The report of the directors to the seventeenth half-yearly ordinary general meeting, held yesterday (the 27th January), stated that the accounts and balance-sheet for the six months ended 30th September, 1880, show the Company's revenue for this period amounted to £268,128 15s. 5d., from which is deducted £68,039 12s. 4d. for the ordinary expenses of the Company, and £30,476 7s. 2d. for expenditure relating to repairs of cables during the half-year, as shown in the annexed accounts, which, with £3,276 5s. 6d. for income tax, leaves a balance of £166,336 10s. 5d. From this amount, £43,081 2s. 4d., the interest on debentures and the dividend on the 6 per cent. preference shares to the 30th September, 1880, together with two interim dividends on the ordinary shares for the quarters ending 30th June and 30th September, 1880, amounting together to £137,906 2s. 4d., have been paid, leaving a balance of £28,430 8s. 1d. to be carried forward. The several sections of the Company's cables are in good working order, with the exception of the Direct Lisbon Cable, laid in 1870. This cable has been a source of great expense to the Company, owing to very frequent breakages caused by the great irregularity of the bottom of the ocean. In 1876 a break occurred in 2,000 fathoms water, and pending a favourable opportunity for effecting repairs at this depth, arrangements were made for an alternative land line through Portugal, connected by a short cable with Vigo. As, however, the land line and also the Company's duplicate cable between Vigo and Lisbon were interrupted every winter, endeavours were made last summer to restore the direct cable,

and change the position of the Vigo-Lisbon cable. Both of these operations were successfully accomplished. The directors regret, however, to report the breaking of the direct cable within three months after it was repaired; but as the interruption has occurred in a portion of the new cable so recently laid, no doubt is entertained of the restoration of the line by the Company's repairing ship *Chiltern* early next summer. The revenue above mentioned includes the dividends for the half-year in respect of the Eastern and South African line, which is worked by this Company, and in which the Company hold nearly all the shares. The Eastern and South African Telegraph Company, after paying all working expenses and charges for debenture interest and sinking fund, have paid a dividend of 9s. per share (£10) for the nine months ending 30th September last (the period since the line was opened for traffic), being at the rate of 6 per cent. per annum, placing £2,500 to a reserve fund for maintenance ship and hulk, and £25,000 to a general reserve and renewal fund, and carrying forward a balance of £5,124 0s. 7d.

Mr. J. Pender, having moved the adoption of the report, the same having been seconded, in reply to questions alluded with satisfaction to the existing state of affairs as to the Eastern and South African Telegraph Company and the arrangements they made respecting it. If their policy were followed, he hoped that that undertaking would some day be an appendage of the Eastern Company without having cost them very much. There had been a considerable advance in the value of their property since the picking up of the Direct Lisbon cable under the circumstances referred to. There was no doubt that with increased trade in Egypt their revenue as regarded that country would also increase. On the authority of Sir James Anderson they considered that the new cable had been broken just upon the edge of the bank where the water deepened suddenly, and that the part of the cable that was new would be repaired inexpensively. The breakage was through no defect in the cable. He thought that a permanent 5 per cent., with the prospect of a bonus, was better than a fluctuating dividend. Their reserve fund was £300,000, as against a capital expended of £5,000,000. If they had £500,000 at the credit of reserve fund they could replace any of their cables without going to the public for money. The motion was unanimously adopted.

The directors of the Globe Telegraph and Trust Company announce an interim dividend of 3s. per share on the preference shares, and of 1s. 6d. per share on the ordinary shares.

The Submarine Telegraph Company have removed their offices to No. 2, Throgmorton Avenue, London Wall.

The Eastern and South African Telegraph Company, Limited, announce the restoration of telegraphic communication with Cape Colony, Orange Free State, and Griqualand West.

The superintendent in England of the "Compagnie Française du Télégraphe de Paris à New York" informs us, under date the 17th inst., that the fault in their Brest-St. Pierre cable has been removed, communication to America by this Company's line being thus restored. The vessel which effected restoration, the s.s. *Pouyer Quertier*, left Havre on the 11th inst., and the repair was completed on the 16th. This promptitude on the part of Mr. Dieselhorst and his staff stands out in striking contrast to the failure to repair the Brest cable of the Anglo Company, mentioned on p. 15 in our issue of the 1st of January.

With reference to the reports of new Atlantic cable competition, we may state that Mr. Jay Gould has contracted for the manufacture of two cables, and that they are already being constructed by Messrs. Siemens Brothers & Co., Limited. Last week it was reported that Mr. Jay Gould has arrived in London; this was, and is still, we believe, incorrect.

The following are the final quotations of telegraphs for Jan. 28th:—Anglo-American, Limited, 60-60½; Ditto, Preferred, 88-89; Ditto, Deferred, 32-32½; Black Sea, Limited, ——; Brazilian Submarine, Limited, 9⅞-10⅛; Cuba, Limited, 8¾-9¼; Cuba, Limited, 10 per cent. Preference, 16¾-17¼; Direct Spanish, Limited, 2⅞-3⅛; Direct Spanish, 10 per cent. Preference, 12¼-12¾; Direct United States Cable, Limited, 1877, 10¾-11¼; Scrip of Debentures, 101-103; Eastern, Limited, 9½-9¾; Eastern 6 per cent. Preference, 12⅛-12⅞; Eastern, 6 per cent. Debentures, repayable October, 1883, 102-106; Eastern 5 per cent. Debentures, repayable August, 1887, 102-105; Eastern, 5 per cent., repayable Aug., 1899, 104-107; Eastern Extension, Australasian and China, Limited, 10⅛-10⅜; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 110-113; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 104-106; Ditto, registered, repayable 1900, 104-106; Ditto, 5 per cent. Debenture, 1890, 102-104; Eastern and South African, Limited, 5 per cent. Mortgage Debentures, redeemable 1900, 101-103; Ditto, ditto, to bearer, 101-103; German Union Telegraph and Trust, 9¾-10¼; Globe Telegraph and Trust, Limited, 6⅜-6⅝; Globe, 6 per cent. Preference, 11⅝-12⅛; Great Northern, 11-11¼; Indo-European, Limited, 26-27; London Platino-Brazilian, Limited, 5¾-6¼; Mediterranean Extension, Limited, 2½-3; Mediterranean Extension, 8 per cent. Preference, 10½-11; Reuter's Limited, 10¾-11¼; Submarine, 265-270; Submarine Scrip, 2½-2¾; West Coast of America, Limited, 4-4½; West India and Panama, Limited, 1⅜-1⅝; Ditto, 6 per cent. First Preference, 6½-7; Ditto, ditto, Second Preference, 5¾-6¼; Western and Brazilian, Limited, 7¾-8; Ditto, 6 per cent. Debentures "A," 106-110; Ditto, ditto, ditto, "B," 98-101; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 120-125; Ditto, 6 per cent. Sterling Bonds, 104-107; Telegraph Construction and Maintenance, Limited, 36-36½; Ditto, 6 per cent. Bonds, 103-106; Ditto, Second Bonus Trust Certificates, 3½-3¾; India Rubber Company, 18½-19; Ditto, 6 per cent. Debenture, 107-109.

TRAFFIC RECEIPTS.

Name of Company.	December.		Increase or Decrease.
	1880.	1879.	
	£	£	£
Anglo-American.........	*	...	...
Brazilian Submarine...	†18,900	12,624	...
Cuba Submarine	2,300	3,317	Dec. 1,017
Direct Spanish	1,520	1,551	Dec. 31
Direct United States...	*	...	...
Eastern	48,776	45,704	Inc. 3,072
Eastern Extension	28,010	26,025	Inc. 1,985
Great Northern	16,800	16,936	Inc. 136
Indo-European	...	...	...
Submarine	*	...	...
West Coast America ...	...	...	...
Western and Brazilian	13,038	11,496	Inc. 1,542
West India	...	...	...

* Publication temporarily suspended.
† Five weeks 1880 compared with four weeks in 1879.

THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. IX.—No. 193.

THE THEORY OF ELECTRIC LIGHTING.

THE electric light has now been established on such a firm basis that any doubts which may previously have existed with regard to its chances of success have entirely died away. But although the practical progress has been great, the laws upon which a correct calculation of the economy of the light must be based seem as far from being understood or discovered as ever. This is partly due, no doubt, to the fact that practical men are seldom good mathematicians, and whilst they can form a rough estimate of the value of the performance of any particular machine or lamp in which they are interested, they fail to see in what way any variation from the existing order of things tends to affect the economy of the work performed.

It is almost impossible to see in what way the various elements which constitute the laws governing the action of dynamo machines affect one another without a good knowledge of mathematics.

The only method by which fair comparisons can be made between various machines without somewhat complicated mathematical investigations being introduced, is by working each machine under exactly the same conditions.

The question of efficiency as regards light produced is but very little affected by the class of lamp employed. Every arc lamp, no matter by what mechanism it is regulated, practically gives the same amount of light for a given current. It is in the dynamo machine that the question chiefly lies.

Up to the present time no single satisfactory trial of various machines has yet been made, principally because machines of a different class have been entered into competition one against the other. If any satisfactory results are to be obtained it would be by trying the various types of machine, *each wound to the same resistance*, and then with a given horse-power to determine the amount of current generated by each machine. To try a high resistance machine of one type against a low resistance machine of another type is, in our opinion, to render any comparison quite erroneous. The question of high *versus* low resistance is one thing, the question of the form of the inducing and induced magnets and of the bobbins is another question; the two should be tried quite independently, otherwise no satisfactory result will be arrived at. If the mathematical law-governing the action of the machines were unders stood, results obtained from various machines could be reduced to a standard, but at present this seems out of the question.

As regards lamps, the question of arc *versus* incandescence can only be fairly settled by determining with a given current what amount of light is obtained with the two systems; but here again the standard of illumination would require to be fixed—at present it is in a most unsatisfactory state; the ordinary photometric measurements in candle power are liable to great error and misconstruction. There can be little doubt but that the factor of "space illuminated" requires to be taken into consideration in making calculations, and this as yet has not been done.

A good deal of information would be arrived at, with regard to the economy of the electric light, if the measurements of the currents, &c., were made in an intelligent and straightforward manner. Many of the measurements given in trials are, we believe, but little more than guesses at the truth, and are very far from the latter.

As an example of careful and intelligent methods of measurement, we would point out those described in an article on "The Brush system of electric lighting," in a recent number of our contemporary, *Engineering*. The substitution method is here employed for determining the resistance of the lamps, and a balance method for determining the potential of the current. Perhaps the best method of measuring the current strength in a circuit is that of including in the latter a resistance of a definite and known value, such as one ohm, and then measuring the potential between the two ends of the latter by connecting to them a galvanometer having a high resistance in its circuit; in this case the deflection obtained, compared with the deflection from a standard electromotive force inserted in the place of the one ohm resistance, gives at once, and accurately, the potential between the two ends of the latter, and this potential, divided by the resistance, gives correctly the strength of the current. It seems curious that this simple and accurate method is not adopted, instead of employing a tangent galvanometer, which at best is not a satisfactory instrument. The measurement of the current is one of the most important factors in determining the efficiency of a dynamo machine, and it is important that it be measured correctly. But, as we before stated, no measurements are of any value unless their exact signification is understood; in fact, if anything, they tend to mislead rather than to guide.

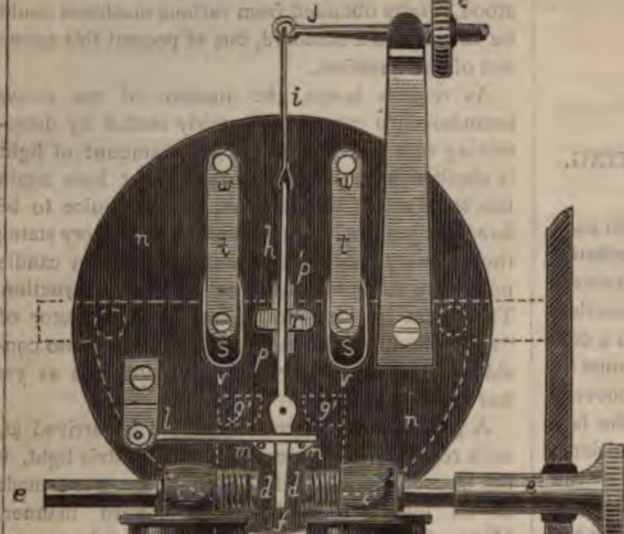


FIG. 1.

FIG. 3.

FIG. 2.

FIG. 4.

FIG. 5.

FIG. 6.

BRIGHT'S SINGLE NEEDLE SOUNDER.

THIS instrument, the invention of Sir Charles T. Bright, is practically an improvement on the ordinary single needle apparatus, and can be adapted to the latter, so that it can be used for reading from either by the eye or the ear. Fig. 1 shows the back of the dial of the improved instrument. Fig. 2 is a side elevation of the same, partly in section. *a*, *a*¹, are two electro-magnetic coils fixed to *b*, the lower pole of a permanent magnet (the middle of which is indicated by dotted lines), by which they are polarised; *c*, *c*¹, are the upper poles of the coils, and the soft iron pole pieces, *d*, *d*¹, pass through the poles, into which they are screwed, and their distance from each other can be regulated by means of adjusting keys applied to the brass square ends, *e*, *e*¹. The adjustment by this means is very delicate, and the polarisation is very perfect, owing to the intimate contact of the screw threads throughout the surfaces. An opening in the outer case of the instrument opposite to the square ends enables any adjustment to be made by the keys without removing the case, as shown by the key at *e*¹ passing through a hole in the side of the case, which is represented in section. *f* is the free end of a movable soft iron armature or tongue, which is polarised by *g*, *g*¹, the upper pole of the magnet, *b*, *g*, and has therefore an opposite polarity to that of the poles, *d*, *d*¹, between which it lies. The other end of the tongue is supported upon pivots in a slot cut in the pole of the magnet between *g*, *g*¹. A lever, *h*, *h*¹, made of aluminium for the sake of lightness, is extended from the axis of the tongue on the upper side of and in the same plane with it. The length of the lever is greater than that of the tongue, so that the application of force at its end has through its greater distance from the axis or fulcrum a leverage or mechanical advantage over the end of the tongue at the point where it is opposite the poles, *d*, *d*¹. The end of the lever is connected by a link of aluminium to the end of a small movable lever or arm, *j*, which is mounted on centres, as shown, and carries an adjustable weight, *k*. By the action of the weight through *i* upon the lever, the latter is retained in its place of rest or zero when no current is passing through *a*, *a*¹. *l* is a light pivotted arm resting upon two pins, *m*, *m*¹, standing out from a small plate fixed upon the tongue near to its axis, by which any vibration of the tongue and lever at the end of a beat or signal is checked. At a point in a line with the lever, about a third part of the distance between its axis and end, a light axle is pivotted in the same plane as the axis of the tongue, one end of which passes through the dial plate, *n*, *n*; and carries a light external indicating pointer or needle, *o*, *o*, and the other end inside the dial carries a short arm, *p*, *p*, which is slotted or forked at its upper end, and is engaged by a pin, *q*, projecting from the lever. At another point in the lever, about as far from its fulcrum as the length of the tongue, the hammer, *r*, is fixed. Two sounders, *s*, *s*¹, to be further described hereafter, are fixed by means of the steel plates, *t*, *t*, and studs, *u*, *u*, to the back of the dial plate, and the sounders serve as stops to limit the motion of the hammer and lever and of the needle outside the dial. Figs. 3 and 4 show the back and side views of the detached needle or indicator, *o*, *o*, with its slotted or forked arm, *p*, and the pin, *q*, which projects from the lever, *h*, *h* (figs. 1 and 2), and moves the needle to the right or left as the current through *a*, *a*¹, is positive or negative. *v*, *v* (fig. 1), are perforations in the dial, through which the sound is emitted, or through which the mouths of the sounders protrude. Fig. 5 shows the front of the dial, *n*, *n* (figs. 1 and 2), *o*, *o*, being the needle; *s*, *s*, are the mouths or outer ends of two flat-shaped tubes or sounders, corresponding to the parts indicated by the same letters in figs. 1 and 2, which enter into or are immediately opposite, and close to but not touching the sides of *v*, *v*, the two perforations, which are similar in shape to but a little larger than the mouths of the sounders. *w* is an opening in the dial to facilitate the adjustment of *d*, *d*¹ (fig. 1); *x*, *x*, are two small circular plates of ivory let into the dial, corresponding to the stops or pins of the ordinary needle instrument, but which are really false stops or indicating points, as the needle is not stopped against them, their surfaces being flush or nearly so with the dial. Upon the dial the letters of the alphabet and signs representing the beats to each side by which the letters are expressed are painted, as shown in the figure. The front of the dial is painted black, the needle white, and the lettering pale green, an arrangement which renders the visual signals very distinct to the operator. Fig. 6 shows a side view of one of the sounders, *y* being the outer or exposed end or mouth which is open, and *z*, the end inside the dial or screen which is closed, and is fixed to *t*, the metal plate, by which it is fastened to the stud, *u*, in figs. 1 and 2. *n*, *n*¹, show a section of part of the dial plate. The sounders are made of German silver. The instrument is stated to be more powerful than any of the instruments now in use in which signals are made to both sides of zero, either visually or direct to the ear, except by the aid of a relay and local battery. The current necessary to work it is comparatively small, and it is estimated that three-fourths of the battery power employed for working needle instruments might be saved if it were generally used. It is stated that with an ordinary Leclanché battery of 10 cells readable signals may be obtained, if the instrument is in proper condition, through 20,000 ohms resistance, and good audible signals through 12,000 ohms.

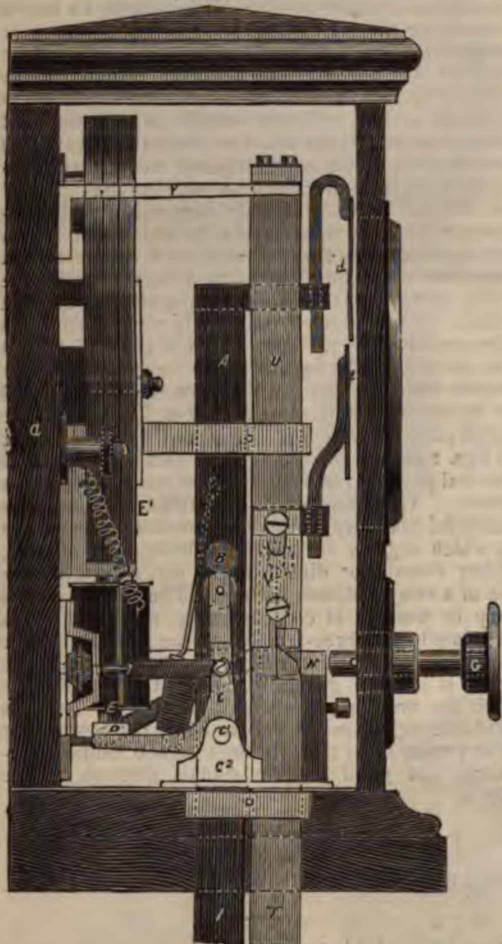
SYKES' RAILWAY SIGNAL APPARATUS.

THE object of this invention is to control the movements of signal levers by electrical action at distant stations.

The operation or working of the system at three given stations or signalling points, A, B, and C, is such that a lock at A is released by the forward motion of the starting lever at B, and the signal "clear" on an indicator at A is given by motion from a plunger at B. When the plunger has been acted upon to give the signal "clear" at A, as just mentioned, it cannot be acted upon again until the starting lever at B, which has been locked in its normal position, has been released by C. The

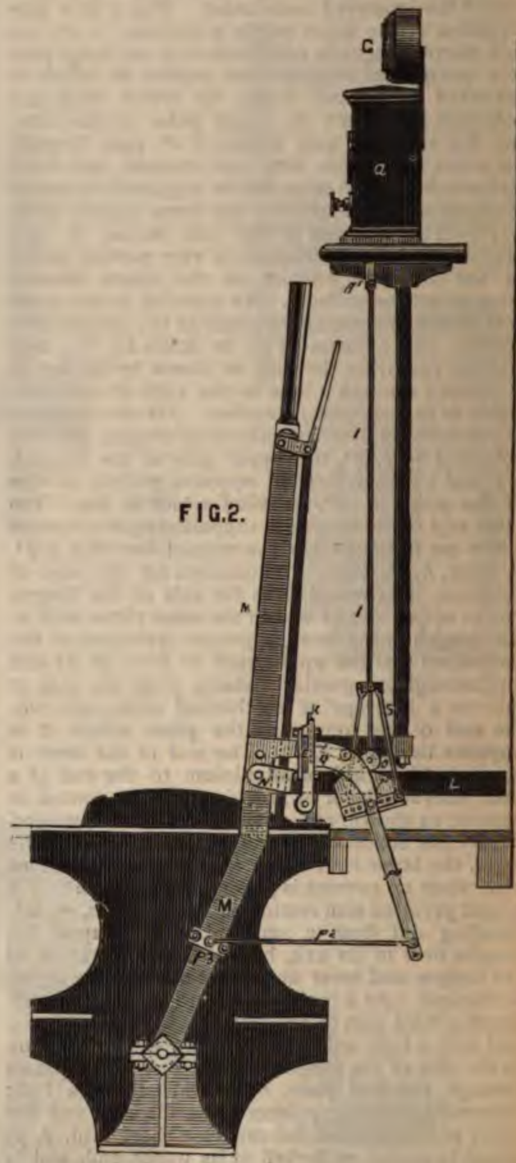
starting lever at B when in its other position, that is, when pulled over and the signal is down, is locked, and is released either by a treadle in advance of the signal or by a plunger under the control of the station staff at B; also, when the starting lever at B is pulled over and the signal is down, the plunger which releases A is locked until the train

FIG. 1.



has passed over the treadle in advance of the starting signal or until the platform plunger has been used. Thus the signalman at B cannot give "clear" to A until B has given the train on to C, and C has released B's starting lever, which B must pull over and again put back after it has been released by the treadle or platform plunger, as above described. The back motion of B's starting lever brings two springs into contact, which then send a reverse current to a galvanometer at A, thus indicating to the signalman at A that the section of the line between A and B is "clear" (but not unlocking the lever at A), and that he can ask the signalman at B to accept another train, which the latter can do by a bell worked electrically or a telephone. No other

FIG. 2.



block instruments are required, because not only is the galvanometer a block instrument in itself, but also the indicator is both a block and locking instrument.

Each signalman has in front of him, and over the lever, a case which contains the lock. The case has two oblong openings, behind which and within the case are indicating pieces, *d* and *e*, of tin; the piece, *d*, behind the upper opening is painted on the upper

half "clear" and on the lower half "blocked;" the tin, *e*, behind the lower opening, is painted on the upper half "train on," and on the lower half "train passed" or "clear." The pieces of tin are attached to blades marked respectively A and U, which pass through the bottom of the case, and are jointed to rods which are attached to the lower gear. The blade, A, to which is attached the upper tin, *d*, with the words "blocked" and "clear," is held up by an angle-piece, C (mounted on a stud, C^1, and bracket, C^2), which angle-piece rests under a pin, B. Part of the angle-piece is an armature, D, held up by the poles of an electro-magnet, E, which is attached to permanent magnets, E^1. The electro-magnet communicates by a wire through a galvanometer, G, with a spring in a case at the station in advance, which spring is put in communication with a battery by means of a plunger and angle-piece at this station, similar to those represented respectively at G and H, in fig. 1. The blade, A, is jointed at A^1 (fig. 2) to a rod, I, which is attached to a crossbar, J, lifting a sliding piece, K (which forms a lock), out of and into a notch, *f*, cut in a tappet, L. This tappet is attached to the signal lever, M, by means of a stud, N. Attached to the crossbar, J, is a roller, O, which is lifted by a cam, P, carried by a bracket, Q. This bracket is bolted to the bar, R. Mounted on the cam, P, is a T-shaped arm, P^1, connected by a rod, P^2 (fig. 2), to a pin plate, P^3, bolted to the signal lever, M. To a stud, R^1, in the cam, P, is attached a rod, S, which works a blade, T, forming a continuation of, but being a distinct piece from, the blade, U. This blade, U, which carries the lower tin piece, *e*, with the words "train on" and "clear," is held up by a click, V, which rests on a pin in the blade, T. The click, V, is pushed off the pin in this blade, T, by means of the plunger, G, and angle-piece, H, and this causes the blade, U, carrying the lower tin piece to drop. This blade, U, is put up by the signal lever, M (fig. 2), being pulled over, and as this lowers the blade, T, by means of the rod, S (fig. 2), which works it, the pin on T (fig. 1) is allowed to get underneath the click, V, so that the backward motion of the signal lever then raises both the blades, T and U.

When the signal lever is put back two springs mounted on a bracket, Y, are pressed together by the blade, U, and a contact being thus made electric communication is carried to the galvanometer at the station "A" in the rear, which pulls the arm at that station to the "clear" position, and being a current from a different battery reverse to that sent by the plunger spring, before referred to, it does not repel, but attracts, the armature of the electro-magnet, E, in the case at the rear station, "A," and therefore does not unlock the signal lever.

By means of the treadle before referred to the passing of the last carriage of a train sends a current to the electro-magnets, E (fig. 1), and causes them to repel the armature, D (fig. 1), thereby dropping the blade, A, which carries the upper tin piece, and taking out the back lock so that the starting lever can be put back, and the "clear" signal be given to the station in the rear, the lever being itself simultaneously locked. As has been pointed out, this may be done by a hand plunger.

TELEGRAPHIC APPARATUS IN USE IN THE BRITISH POSTAL TELEGRAPH DEPARTMENT.

XXVII. THE WHEATSTONE AUTOMATIC SYSTEM.—(*Continued.*)

CONSIDERABLE inconvenience was found to arise from the breaking of the driving chain in the transmitter instrument, and as the links were made opened and closed again with a pair of plyers, and which could consequently be substituted for the broken link without trouble. Such soft links were,

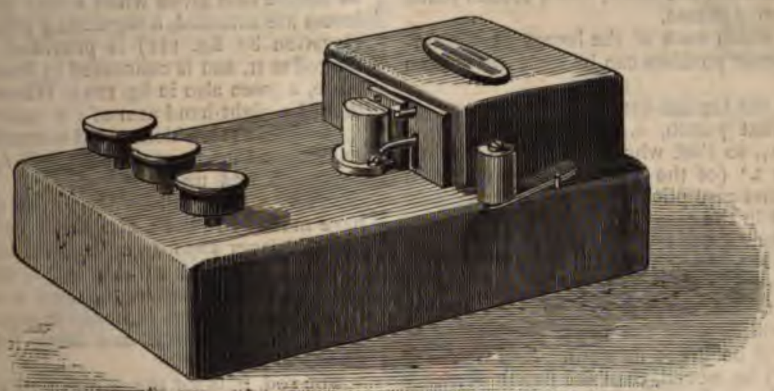


FIG. 108.

of steel great difficulty was experienced in repairing the damage, which practically rendered the instrument useless. To overcome this defect links of *soft* steel used to be provided, which could be easily however, necessarily wanting in strength, and recently a stronger chain has been used with links of a peculiar make, which enabled any break to be repaired with the utmost facility and efficiency.

The openings of the new links are V-shaped, as shown by fig. 107; this device allows of any two links being "snapped" together with the greatest ease when held as shown in the right hand of the figure.

Care must be taken in joining a chain to see that there is no twist in it, as when the links are once

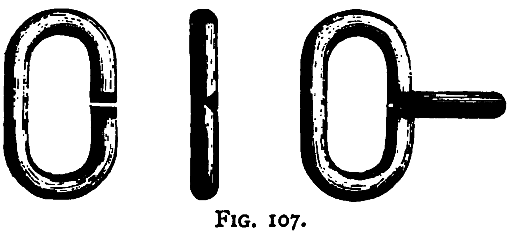


FIG. 107.

"snapped" together they cannot be separated. Should a twist accidentally occur it is necessary to break a link for the purpose of righting it.

THE PUNCHER.

The general form of the "Puncher" for punching the perforations in the transmitter slip is shown by fig. 108. It consists of a cast-iron box, the underside of which is shown by fig. 109, provided with three keys in the front; these keys are connected to punches, which on being actuated by the depression of one or other of the former, perforate holes in a strip of oiled paper.

The three keys are connected severally to three levers, L^1, L^2, and L^3 (fig. 109), which are hinged in the block, B, at V_2. The shape of these levers is shown in L^3 (fig. 110); on the end, l, being struck down by one of the keys the steel-faced end, l_1, is urged forward and pushes one or more of the punches, a, b, c, d, or e.

The lever, L^3, pushes forward the punches, a, c, and e.

The lever, L^1, pushes forward the punches, a, b, and d.

And the lever, L^2, pushes forward the punch, d.

The ends of these punches pass through a steel plate, D, and between the latter, and a second plate, D_1, the paper strip passes.

The way in which each of the levers pushes forward the particular punches can be understood from fig. 110.

Referring to the top left-hand figure in fig. 110, it will be seen that punch, a, has attached to it a branch-piece, a_1, so that whether lever, L^1 (of the "dot" key) or L^3 (of the "dash" key) be pressed forward, in either case punch, a, will produce a perforation, which in the case of lever, L^3, corresponds to the top perforation of the "dash," and in the case of lever, L^1, to the top perforation of the "dot."

Referring now to the lower figure it will be seen that if lever, L^3 (of the "dash" key) be struck, the punch, c, which gives the lower perforation of the "dash," will be urged forward. And if L^1 (of the "dot" key) be moved, then the punch, b, which gives the lower perforation of the "dot," will be urged forward.

Lastly, we can see from the middle figure that if the "dot" lever, L^1, be pressed, then the punch, d, giving the "rack" perforation, will be urged forward; and if lever, L^3, be moved, then the punch, e, will give the rack perforation; and, again, if lever, L^2 (the "spacing" lever) be depressed, then the "rack" perforation from the punch, d, only will be given.

Thus each lever moves the punches required to give the perforations corresponding to it.

After each lever has been depressed and the punches corresponding to it have done their work, the paper requires to be drawn forward to the position at which the next perforations are to be made; this is done by means of the star wheel, s (fig. 111). The teeth of this star wheel fit into the "rack" perforations in the paper slip and draw it forward by a "rack and pinion" movement.

A pawl, p, drops into the teeth of the star wheel, being pressed against the latter by a wheel, w, which is itself pressed against p by a spring, x (fig. 112). The pawl, p, is hinged at the end of a lever, r, which is itself hinged at f to a lever, r_1; this latter lever is hinged at g, and is pressed forward by the action of the levers, L^3, L^1, L^2. A strong spring, S, is connected to r by a link, k, and by its tension draws r against a stop, i, which thus acts as a fulcrum. It is evident, then, that if r_1 be pressed by the levers, L^1, L^2, or L^3, that it will turn about the centre, g, and that the hinge-pin at f will cause r to turn round the centre, i, and thus move the long arm of r to the left, and pull the pawl, p, to the left. When the levers, L^1, L^2, and L^3, return to their normal positions after being moved, then the levers, r_1, r_2, will be drawn back to the position shown in fig. 111, and the pawl, p, engaging in the teeth of the star wheel, s, will turn it round the distance necessary to move the paper forward the proper amount.

The exact distance the pawl, p, can turn s is regulated by the bent lever, L, which is adjusted by two screws, s_1, s_2.

The regulation of this lever should be such that if 121 "rack" perforations are made in a piece of paper slip, then the distance between the centre of the first and last holes should be as nearly as possible 12 inches.

As it is necessary that the movement forward of the paper slip after the lever, L^3, is worked should be double that given when either of the other two levers are actuated, a regulating piece, t (shown in elevation by fig. 111) is provided. This piece is hinged at H, and is connected to lever, L^3, by a tail-piece, z (seen also in fig. 109). When L^3 is actuated, then the right-hand arm of t is raised, and the end, e, of r (fig. 111), which would normally be limited in its left-hand movement by the tail, t_1, can now pass beyond it and up to the stop, y. Thus, when r returns to the position shown in fig. 111, it will have moved s round a distance equal to two teeth, and the paper slip forward a corresponding distance.

When L^1 or L^2 are depressed, then the movement of r is limited by the end, e, coming against t_1; thus the pawl, p, can only engage with s in such a way as to move it one tooth forward when it recoils to the right.

The rod, D, is for the purpose of moving the star wheel by hand in case the paper slip sticks, as it sometimes does.

E is for the purpose of pushing back the punches in case they stick, as is sometimes also the case.

The little tongue, F, which is pressed upwards by the spring, s_3, keeps the paper slip in position as it passes before the punches.

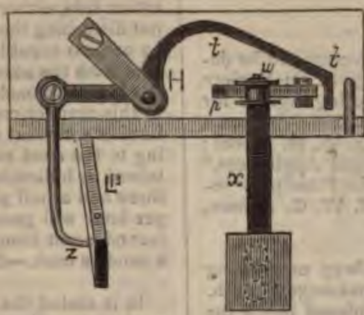


FIG. 112.

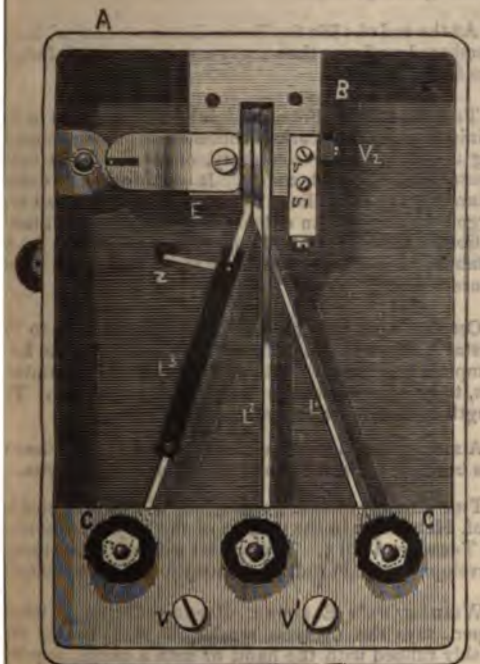


FIG. 109.

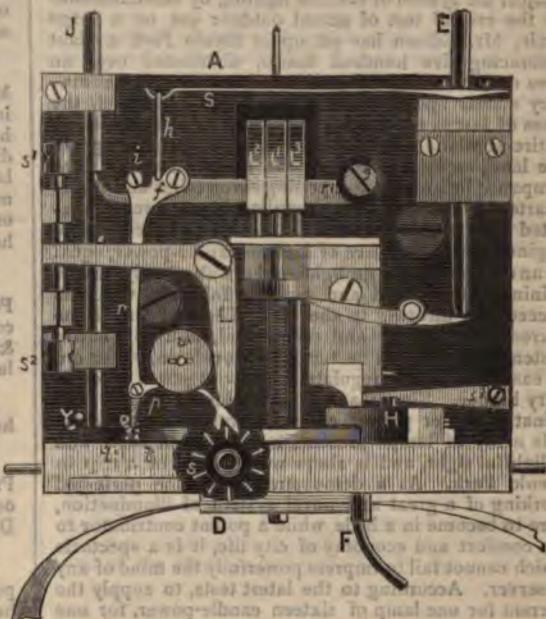


FIG. III.

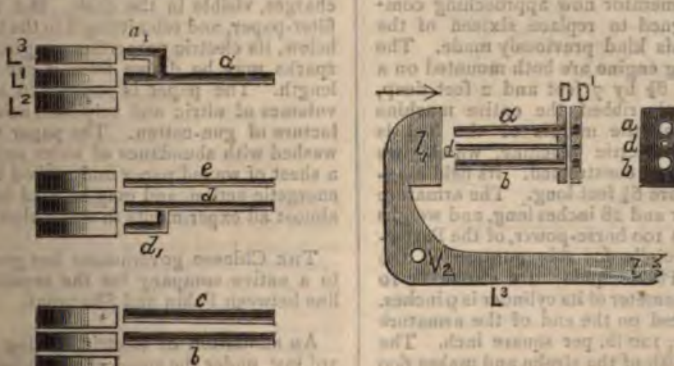


FIG. 110.

Notes.

Amongst the papers to be read and lectures to be delivered at the ordinary general meetings of the Society of Arts, will be the following:—"Flashing Signals for Lighthouses," by Sir William Thomson; "Recent Advances in Electric Lighting," by Mr. W. H. Preece; "The Future Development of Electrical Appliances," by Prof. John Perry; "The Scientific Principles involved in Electric Lighting," by Prof. W. G. Adams, F.R.S.

The carriages of the electric railway now being erected in Berlin will carry twenty passengers each. The driving dynamo machine will be placed below the floor of each carriage. A speed of twenty miles an hour is expected to be attained.

Electric Illumination at Menlo Park.—To subject his system of electric lighting by incandescence to the crucial test of actual outdoor use on a large scale, Mr. Edison has set up at Menlo Park a plant embracing five hundred lamps, distributed over an area one mile long and half a mile wide. His laboratory stands upon a gentle eminence from which the lines of lamps extend half a mile to right and left, the entire area under illumination being, from the slope of the land, easily visible from the central station. The lamps are in a circuit comprising seven miles and three-quarters of wire, and are supplied by a current generated by nine dynamo-electric machines driven by one engine. The lamps are of sixteen candle-power, equal to an ordinary street gaslight, and are absolutely steady, shining with a mild and serene effulgence, which is exceedingly pleasing to the eye. The division of the current is complete and economical, and the entire system of lights can be turned up or down, off or on, as easily as one can regulate the flow of gas in an ordinary burner. Simply as an exhibition of perfect illumination under perfect control, covering a vast area, this array of lamps presents a most remarkable and delightful sight, and is alone well worthy of a trip to Menlo Park. As a demonstration of the perfected working of a great and novel system of illumination, sure to become in a little while a potent contributor to the comfort and economy of city life, it is a spectacle which cannot fail to impress powerfully the mind of any observer. According to the latest tests, to supply the current for one lamp of sixteen candle-power, for one hour, requires the consumption of two-fifths of a pound of coal. Still greater economy of power is expected by the use of the large generator now approaching completion. This is designed to replace sixteen of the largest machines of this kind previously made. The dynamo and the driving engine are both mounted on a massive cast-iron bed, 8½ by 7 feet and 2 feet deep, very heavy and strongly ribbed, the entire machine weighing 8 tons. Near the middle of the bed is mounted the dynamo-electric machine, which, we believe, is the largest ever constructed. Its field magnets, three in number, are 6½ feet long. The armature is 21 inches in diameter and 28 inches long, and weighs 1½ tons. The engine is 100 horse-power, of the Porter-Allen type, built especially for this purpose at the Southwark Foundry, Philadelphia. Its stroke is 10 inches. The internal diameter of its cylinder is 9 inches. The crank disc is placed on the end of the armature shaft. Steam pressure, 120 lb. per square inch. The engine cuts off at one-fifth of the stroke and makes 600 revolutions per minute. The working pressure of the dynamo is 140 volts; the resistance of the armature is one two-hundredth of an ohm. The current is taken from the commutator cylinder by twelve brushes, six on either side, either one of which may be removed without disturbing the others. These brushes are supported by an arm capable of being rotated on an axis coincident with the axis of the armature, so that they may be made to approach or recede from the neutral point, and in this manner control the current. This machine will furnish a current to 800 incandescent lamps. According to the most recent estimates as to economy, as obtained by indicating his present engine with 500 lamps, three and a half pounds of coal burned under the boiler per hour will generate a nett current sufficient for 8½ incandescent lamps of 16 candles each, or 16 lights of 8 candles each.—*Scientific American.*

It is stated that an 800 horse-power engine will be used at the Electrical Exhibition at Paris to work 600 electric lamps, which are to be distributed about the building and grounds.

At the end of 1880 the Berlin Electro-technical Union numbered no fewer than 1,575 members, 1,246 of whom are foreigners.

The director of French Lighthouses has sent to the Minister of Public Works a communication recommending the lighting, by electricity, of all the great lighthouses on the French coasts. It will involve an expenditure of several millions of francs, which will end in a large economy and an extension of the range of illumination. A system of steam-trumpets is also to be established in connection with these improved lighthouses.—*Nature.*

On the 11th inst. an application was made to the Postal Telegraph Department by the War Office for a complete equipment of telegraph *matériel*, operators, &c., to be shipped for the Ashantee coast to-day. The length of line to be erected is ten miles.

A small electric railway, brought over from Vienna, has been set up in the Zoological Gardens, Calcutta.

The Faraday lecture (in English) will be delivered by Prof. Helmholtz in the theatre of the Royal Institution on Tuesday, April 5. The subject will be "The Modern Development of Faraday's Conception of Electricity."

Wiedemann's Electric Paper.—Ordinary letter-paper, says the *Comptes rendus*, if well heated and briskly rubbed with the hand or with a brush, acquires electric properties; it adheres to tables, walls, &c., and on contact with the hand it gives slight electric discharges, visible in the dark. But on taking Swedish filter-paper, and submitting it to the treatment described below, its electric properties are greatly intensified, and sparks may be drawn from it several centimetres in length. The paper is steeped in a mixture of equal volumes of nitric and sulphuric acid, as in the manufacture of gun-cotton. The paper thus pyroxilised is washed with abundance of water and dried. If laid on a sheet of waxed paper and rubbed briskly it manifests energetic action, and may be used for the repetition of almost all experiments in static electricity.

The Chinese government has granted a concession to a native company for the erection of a telegraph line between Pekin and Shanghai.

An exhibition of electric lighting took place on the 3rd inst. under the auspices of the British Electric Light Company (Limited), in the large hall of the Palace Chambers, Bridge Street, Westminster, the object of the gathering being an inspection, with the aid of

practical illustrations, of Mr. Lane Fox's system of lighting and apparatus applicable for domestic use. The visitors, who were received by the directors of the above company, including the chairman (Mr. Joseph Hubback), were numerous, and included Mr. Shaw Lefevre, M.P., Lord and Lady Penrhyn, Lord Rae, Sir Charles Bright, Lady Frere, Lady Allen, Sir James M'Garel Hogg, M.P., and Lady Hogg, Sir Henry and Lady Green, Mr. Barty Mitford, Mr. Street, R.A., Sir G. Dasent, Lady Stanley of Alderley, Mr. Fitzroy Campbell, Admiral Sir E. Sotheby, Admiral Sir E. Inglefield, Sir A. Borthwick, Mr. P. W. Clayden, Colonel Peters, Dr. Leigh Adams, Major Harding, General Hyde, Colonel Woodhull, Mr. and Mrs. Spottiswoode, Mr. Ponsonby Fane, Professor Frankland, Professor Adams, &c. The hall was lighted by fifteen small incandescent lights, worked by a Gramme machine. The regulation of the motive force is automatic, and the currents are controlled by the generator. Mr. Fox estimates that if electricity were used on the same scale or to the same extent as gas the cost of producing an equal amount of light would be only about one-tenth. Mr. Fox maintains that electricity is, under his system, applicable for economical heating and cooking no less than for illumination. The "Lane Fox" lamp is almost identical with that of Edison, Swan, and Maxim, with certain important additions on the method of distribution and regulation. The British Electric Light Company have the sole rights in Mr. Fox's patents.

The following table is given by *Engineering*, in an article on the "Brush system of electric lighting," which shows well the capabilities of the system:—

Resistance:	
Resistance of the machine between terminals	10·55 ohms.
Resistance of external circuit ...	72·96 "
" whole " ...	83·51 "
" the sixteen arcs ...	70·86 "
Current:	
Electro-motive force of current ...	839·02 volts.
Volume of current	10·04 webers.
Power:	
Total driving power required ...	15·48 H.P.
Driving power absorbed in production of current	13·78 "
Energy of current expressed in horse-power	11·285 "
Percentages:	
Percentage of current available for external work	87·36
Percentage of current appearing as heat and light in the sixteen arcs	84·00
Percentage of gross power converted into current	72·90
Percentage of absorbed power converted into current	81·89
Percentage of gross power appearing in arcs	61·24
Percentage of absorbed power appearing in arcs	68·79

THE experiments for lighting a portion of the Marine Parade, Brighton, by electricity will shortly be made, temporary lamp pillars having already been erected on a portion of the Parade just eastward of the Chain Pier, and at a point where the light will fall both on the Esplanade and on the roadway at the foot of the cliff, known as the Undercliff Road. Four lights will be used for the experiments, which have been intrusted to Messrs. Siemens.

M. O. F. GRANDT, in a communication to the Académie des Sciences, proposes to propel ships by a novel method. The engines are to work dynamo machines, the current from which is to be used to decompose water, the mixed gases from which are then exploded in a tube at the stern of the ship, which thus drives the latter forward. A Grand(t) notion!

MR. CROMPTON informs us that at Wintherthur, Professor Hagenbach has been carefully carrying out some trials with the Bürgin machine recently made by Mr. Crompton in England. The Professor tested the Bürgin machine with an alternating current machine of Messrs. Siemens' and Halske's construction. The Siemens' machine with excitor, and with six differential lamps in circuit, took 8 horse-power, dynamometrically measured. The candle-power was at the same time noted by the chief engineer of the gas works at Wintherthur. The electric lights were compared with an argand burner of 25 candles, and this was again compared from time to time with the normal standard candle. The photometric and dynamometric measurements were simultaneous. The results were as follows:—

Siemens' machine, 6 lights, each of 350 candles, measured on horizontal line 8 horse-power, the total of candles per horse-power being 262.

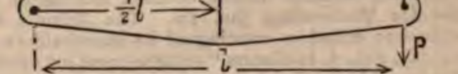
Bürgin machine, 3 lights, each of 1,360 candles, measured on horizontal line 5 horse-power, the total of candles per horse-power being 800.

Bürgin machine, 4 lights, each of 700 candles, 4·9 horse-power; total candles per horse-power 560.

Mr. Crompton says these compare with the best results obtained at Glasgow with the Gramme machine; in that case the candle power obtained was 590 per horse-power, measurements being taken horizontally in this as in the former cases.

As *relative* results we do not think the foregoing experiments of much value. If the same number of lights had been employed in each case something might have been arrived at, but total candle-power divided by horse-power when the number of lamps vary is not a fair comparison.

The horse-powers in these experiments were measured by means of an ingenious dynamometer, of which we give an illustration. The instrument was placed between the driving power and the dynamo machine; it consists of three axles with gearing wheels of one metre circumference. A spring balance is fixed to the end of the lever, *l*, and indicates by the pressure of



the teeth of one wheel on the other the amount of force exerted. This pressure multiplied by the number of revolutions per minute gives the power expended in kilogrammetres.

THE *Oesterreichische-Ungarische Post*, in an article on the future position of telegraph officials, concludes with the words:—"The telegraphist will remain the pariah of the civil service. Much work under un-

healthy conditions, no prospect of promotion, early invalidism, and untimely death."

THE number of telegrams despatched in Vienna during the month of December, 1880, was 90,379.

WE understand that in Edinburgh, the central stations of the Scottish Telephonic Exchange and United Telephonic Company are about to be put in connection, in consequence of arrangements, which are all but complete, for the amalgamation of these companies. The Post Office authorities, we are informed, have expressed their willingness to concede largely on the terms they originally proposed to these companies.

EXPERIMENTAL RESEARCHES ON MAGNETIC COERCITIVE FORCE.—D. Kulp.—The author magnetises iron and steel rods in spirals, which he opens before taking out the rods. On percussion, the permanent magnetism of the rods is partly increased, partly diminished, and partly inverted. As a series of induced currents arise in the rods on opening the spiral they have been exposed to magnetising forces in alternating directions, whereby their behaviour is explained.—*Wiedemann's Beiblätter.*

RECEPTION OF PROFESSOR BELL.—A grand reception has been recently given by the Mayor and Corporation of Brantford, to Professor Bell. The reception was attended by about 300 people. After the presentations the Mayor presented an address to Professor Bell, to which the latter made a suitable reply. An address was then presented by the Board of Trade, to which a reply to the following effect was made:—It might not be uninteresting to them, although not connected specially with trade, if he were to make some remarks upon his recent discovery of the photophone. He described it as at present rather a contribution to science than to the world's utilities, but he looked forward to important practical applications. Among them he specified communication between passing ships at sea, lighthouses and the shore, and in case of war communication with distant places could be received without the necessity of any intervening wire. He then described the apparatus and experiments, and added that he had spoken for a distance of 800 or 900 yards, and had sent the musical sound a mile and a quarter, but he saw no reason to anticipate any difficulty but that of the convexity of the earth in transmitting articulate speech by light to any distance.

THE surprising announcement has been made that the two great competing American telegraph companies, the Western Union (with its auxiliary, the Atlantic and Pacific) and the American Union, had decided to amalgamate and form one gigantic organisation. No official announcement of the terms has been made, nor will any be made until they have been submitted to and ratified by the various boards of directors. For this purpose the Western Union called a meeting of the board for Wednesday, Jan. 19. The Atlantic and Pacific has called a meeting of its shareholders for Saturday, Feb. 5, to discuss "an agreement for the sale of the franchises and the property of the company to the Western Union Company." As all the officials refuse to make public the details of this agreement, no positively accurate statement can be given, but the following is believed to be correct: The consolidated company is to retain the title of the Western Union Telegraph Company, with a capital of 80,000,000 dols. To perfect the company a new certificate of incorporation, with the capital fixed at that amount, is to be filed. The shares of the several companies are to be merged in the consolidated company at a valuation of about 129 for Western Union, 113½ for American Union, and 66⅔ for Atlantic and Pacific. This means practically, scrip dividends of 29 per cent. on Western Union, and 13 per cent. on American Union, making the capital of the first, in round figures, 53,000,000 dols. The capital of the American Union is 10,000,000 dols, but it is also pledged to issue 5,000,000 dols. of bonds to the subscribers of the Central Construction Company, which furnished the funds to construct its line. These bonds, it is said, will be issued at once, and for the purposes of consolidation the entire capitalisation of the company, including both stock and bonds, will be taken as the basis. The valuation of its 15,000,000 dols. capital at about 113½ equals, in round numbers, 17,000,000 dols. The capital of the Atlantic and Pacific Company is 14,000,000 dols. stock. It has no bonded debt. At the valuation of 66⅔ per cent., or thereabouts, its capital is not far from 10,000,000 dols. in the consolidated company. The three companies will then come into the consolidated company approximately as follows: Western Union, 53,000,000 dols.; American Union, 17,000,000 dols. and Atlantic and Pacific, 10,000,000 dols.; total, 80,000,000 dols. It is understood that Mr. Gould, Mr. Sidney Dillon, General Eckert and Mr. Russell Sage are to be elected directors in the new company, and that vacancies will be made for them by the resignation of a corresponding number of the present directors of Western Union.—*Operator.*

RE THE EDISON TELEPHONE COMPANY OF LONDON (LIMITED).—This was a petition by a shareholder tried on the 22nd ult. before the Master of the Rolls in the High Court of Justice for the winding-up of this company, which was formed in August, 1879, with a nominal capital of £200,000 in 2,000 shares of £100 each. Under the articles of association, Mr. Edison was entitled to certain royalties during the continuance of certain patents belonging to him, and he also had the right to a voting power upon resolutions to be passed equivalent to one-half of the aggregate votes of the shareholders voting at any meeting. In May, 1880, this company and the Telephone Company agreed to amalgamate, and a new company entitled the United Telephone Company was formed, with a nominal capital of £500,000 in 100,000 shares of £5 each, 23,000 of which shares were allotted as fully paid up to this company as a consideration for the business made over by such company. These shares were the only property now belonging to this company, and the Court was now asked for a winding-up order on the ground that the company had ceased to carry on its business. Mr. McNaghten, Q.C., and Mr. Latham appeared in support of the petitioner; Mr. Millar, Q.C., and Mr. Renshaw, on behalf of Mr. Edison, opposed the petition; Mr. Chitty, Q.C., and Mr. Cozens Hardy for the company, and Mr. Giffard, for certain shareholders supported the petition. The Master of the Rolls said that the company had been formed for the purpose of carrying on telephonic business, and amongst its powers was a power of selling its business. Mr. Edison had not exercised his voting power to prevent the business being sold, as he might have done, and the sale, therefore, so far as he was concerned, was a valid sale. There was no property to divide except the 23,000 shares in the United Company, and Mr. Edison might be entitled to a portion of these shares under the winding-up. In his lordship's opinion an order for winding-up the company ought to be made, and he therefore made an order accordingly.

ON THE NON-EXISTENCE OF RADIANT MATTER IN THE CROOKES' TUBES.—A. Voller.—The writer first objects to the expression "dark space" used by Mr.

Crookes for one of the layers of cathodic light, since this name has been commonly applied to the space situate between the positive and negative discharge. He shows further, by a series of experiments, that the deflection of the discharges by the magnet are determined by the laws established by Hittorf and Plücker; the rays proceeding from the negative electrode behave like a current fixed at one end and freely moved at the other. From the circumstance that conductors charged with static electricity are without influence upon the discharge, the author concludes that the view of Crookes cannot be upheld. The apparent repulsion of two cathode rays directed obliquely towards each other depends, according to the author, on the internal resistance of the cathode rays.—*Wiedemann's Beiblätter.*

ON THE TEMPERATURE OF THE ELECTRIC LIGHT.—Fr. Rosetti.—E. Becquerel showed in 1860 that the temperature of the luminous arc produced by a battery of 80 Bunsen elements is between 2070 and 2100° C, assuming that the luminosity and the heat radiation increase proportionally, according to the law of Dulong-Petit—a supposition not quite accurate at high temperatures. Rosetti throws the heat-rays from a given surface of the electrodes upon a thermic battery connected with an astatic mirror-galvanometer. From a number of experiments with 160 Bunsen elements with Duboscq's lamp, it appears that the temperature of the positive carbon lies between 2,400° and 3,900° C. It is so much the higher the smaller the radiating surface, supposing that the surface includes the extreme point; the temperature of the negative electrode varies between 2,138° and 2,530° C. Hence the temperatures of the extreme points of the electrodes are not below 2,500° and 3,900° C. In a Reynier lamp connected with 8 to 10 Bunsen elements the temperature of the positive carbon amounted to 2,406°—2,734° C.—*Ath. dell. Jor. Venet.*

A NEW GALVANIC BATTERY WITH A CIRCULATING LIQUID.—L. Ponci.—Rectangular troughs of lead, about 17 cm. long and 6 cm. broad, are bent at one end into the form of a beak, and arranged in a sloping position (with a fall of 15 mm.), so that the beak of the first lies over the broad end of the next lower one. In the troughs lies an amalgamated zinc plate, and upon it a coke plate, isolated from it by means of two caoutchouc rings, and perforated beneath the beak of the upper lead trough. The lead troughs are fitted with wires, and the coke plates at their upper ends with pressure screws, by which they are alternately connected. Through a system of such elements there is conducted, by means of caoutchouc syphons, a solution of yellow chromate of potash (200 parts in 2,000 water and 1,000 of commercial hydrochloric acid). A battery of 99 such elements yields an arc equal to that of 60 Bunsen elements, and its action is constant.

CONSTANT GALVANIC ELEMENTS.—J. Moser.—To prevent the solution of sulphate of copper in a Meidinger element from penetrating upwards to the cylinder of zinc fixed above, and to prevent copper from being deposited upon it, Moser suspends, by means of a thread below the zinc cylinder, a slip of zinc a few centimetres in length, upon which the blue vitriol deposits its copper.—*German Patent*, No. 1,723.

MR. SWAN'S ELECTRIC LIGHT.—During the past few days a company has been formed for the purpose of acquiring the right to use Mr. Swan's patent. The company consists of local gentlemen, and is named "Swan's Electric Light Company." The directors are:—J. C. Stevenson, Esq., M.P. (chairman), J. W. Swan, Esq., A. S. Stevenson, Esq., J.P., Hilton Philipson, Esq., James Craig, Esq., Dr. Marz, and J. C. Swan, Esq. Messrs. J. and R. S. Watson, Pilgrim-street, are the solicitors to the company. The capital is £100,000, and the applications for shares have been very numerous. The value of the shares is £10 each.

AURORA BOREALIS.—There is no doubt that the display of aurora borealis, witnessed in Scotland on 31st January, was of unusual grandeur. At Kirkwall it appeared in the zenith about 6 o'clock like a luminous cloud, from which darted rays of light, stretching on either side to the horizon in the east and west; other rays shot up from behind clouds in the northern horizon; and in the south, notwithstanding the presence of banks of clouds, rays were occasionally visible. At times the whole sky, from the zenith downwards to the east, west, and north was brilliantly illuminated; the aurora showing all the colours of the spectrum. The effects produced by the rapid motion and mingling of the many coloured rays were beautiful. Later in the evening the sky became overcast. At Thurso and Wick, between 6 and 8 p.m., the whole southern sky was brilliantly lighted by the aurora. At times the rays darted from the zenith in a northerly direction; at others dispersed towards all points of the compass; the colours the while quickly changing from pale yellow to deep crimson. At Banff the whole heavens were lighted as with flames of fire from all points. Rays of light shot from behind banks of clouds towards the zenith, frequently broadening out into belts, with a peculiar wavy motion. For fully half an hour the phenomena continued with undiminished splendour, and was such a sight as is but rarely witnessed in that part of the country. At Portsoy, from N.E. to N.W., the rays shot up into the zenith, converging to a point. While the rays in the north were of a pale gold colour, those in the west oftentimes assumed a deep crimson. At Aberdeen, Edinburgh, and other places the aurora was observed up to midnight. At Berwick-on-Tweed, when first noticed, between 6 and 7 p.m., the atmosphere was clear, cold, and frosty—the rays of light, after flickering for a few minutes on the northern horizon, shot up in remarkably vivid, but every changing streaks of light towards the zenith, illuminating the greater part of the heavens in the east and west.

TELEPHONY BY THERMIC CURRENTS.—Whilst in telephonic arrangements, based upon the principle of magnetic induction, a relatively considerable expenditure of force is required in order to set the tightly-stretched membrane in vibration, in the so-called carbon-telephones only a very feeble impulse is required to produce the differences in the current necessary for the transmission of sounds. In order to produce relatively strong currents, even in case of sound-action of a minimum strength, Franz Kröttlinger, of Vienna, has made an interesting experiment to use thermo-electric currents for the transmission of sound to a distance. The apparatus which he has constructed is exceedingly simple. A current of hot air flowing from below upwards is deflected more or less from its direction by the human voice. By its action an adjacent thermo-battery is excited, whose current passes through the spiral of an ordinary telephone, which serves as the receiving instrument. As a source of heat the inventor uses a common stearine candle, the flame of which is kept at one and the same level by means of a spring, similar to those used in carriage-lamps. On one side of the candle is a sheet-metal voice-funnel fixed upon a support, its mouth being covered with a movable sliding disc, fitted with a suitable number of small apertures. On the other side a similar support holds a funnel-shaped thermo-battery. The single bars of

metal forming this battery are very thin and of such a shape that they may cool as quickly as possible. Both the speaking-funnel and the battery can be made to approach, at will, to the stream of warm air rising up from the flame. The entire apparatus is inclosed in a tin case in such a manner that only the aperture of the voice-funnel and the polar clamps for securing the conducting wires appear on the outside. The inside of the case is suitably stayed to prevent vibration. On speaking into the mouth-piece of the funnel, the sound-waves occasion undulations in the column of hot air which are communicated to the thermo-battery, and in this manner corresponding differences are produced in the currents in the wires leading to the receiving instrument.—*Oesterreichische-Ungarische Post.*

Correspondence.

A CURIOUS TELEPHONIC CIRCUIT.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—While experimenting with the Gower-Bell telephone on a metallic circuit of 50 m. (each wire), by mistake, instead of the telephone wires 1 and 2 being properly joined, 3 and 4, two independent wires, were substituted at one end of the circuit, the telephone at the other end remaining connected to 1 and 2. Notwithstanding that the only possible path from one telephone to the other was the leakage through the atmosphere of each pair of vertically parallel wires, (the arms being earth wired), speech was distinctly audible both ways.

Yours truly,
E. T. ROLLS.

L. & S. W. Railway,
Exeter, Feb. 4th.

New Patents—1881.

412. "Signals upon railways." T. MASTERS. Dated January 31.

416. "An improved, combined low-water alarm and safety-valve for steam boilers." G. WILSON. Dated January 31.

455. "Signal buoys." F. BARR. Dated February 3. (*Complete.*)

473. "A new or improved system or mode of, and apparatus for, conveying or transporting money, documents, and parcels in mercantile and other like establishments." E. P. ALEXANDER. (Communicated by J. C. White and H. H. Hayden.) Dated February 4.

474. "Galvanic batteries." J. C. and G. FULLER. Dated February 4.

476. "Improved method of, and means or apparatus for, preventing collisions of railway trains." W. L. WISE. (Communicated by Ronfant and Gaye.) Dated February 4.

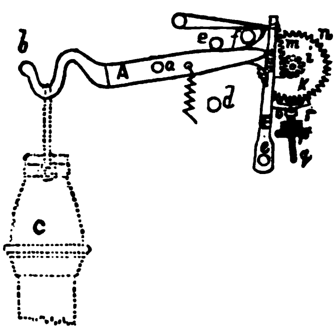
497. "Electro-magnetic induction machines." H. WILDE. Dated February 4.

518. "Signal apparatus for use in building vessels and other places or situations." H. BOTTEN. Dated February 7.

519. "An improved construction of alarm apparatus." P. EVERITT. Dated February 7.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1880.

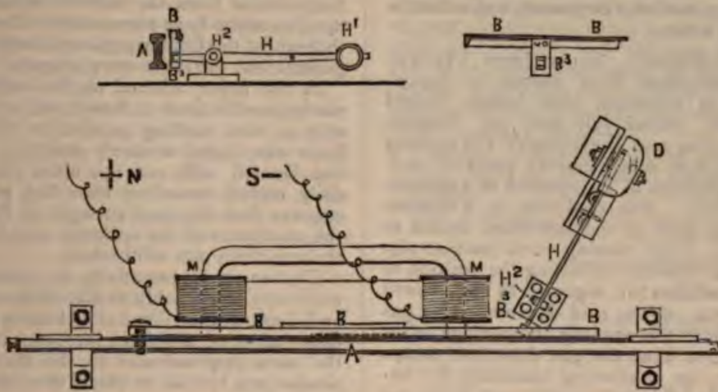
2468. "Apparatus for telephonic signalling." EDWARD HIBBERD JOHNSON. Dated June 18th. 6d. Relates to improvements in that description of apparatus employed in telephonic signalling in which a movable hook or support carrying the telephone receiver is used for the purpose of automatically controlling the connections and effecting the signals. The movement of the lever carrying the hook or support is retarded by the employment of an escapement, thus affording the requisite time for making one or more effective contacts between the signalling battery and the line, whether the hook or support be moving upwards or downwards. A is a vibrating lever mounted upon a centre or fulcrum, *a*, and terminating at its outer extremity in a hook or support, *b*, for carrying the telephone receiver, C, in the usual manner. *c* is a contact screw through which a relay which brings into operation a bell is placed in circuit with the line when the lever, A, is in the position indicated in the figure, with the telephone receiver, C, on the hook or support, *b*. *d* is another contact screw through which the telephone receiver, C, is placed in circuit with the line when the telephone is off its hook or support, *b*, and the bell cut out. E is another vibrating lever mounted upon a centre or fulcrum, *e*. This lever, when A is in contact with *d*, is in contact at its upper extremity with a contact screw, *f*, which places the transmitter in



circuit, the lever being connected at *e* to a conductor leading to the battery, but the lever is out of contact with the said contact screw, and the transmitter is consequently out of circuit, when the parts are in the position shown in the figure. The lever, E, is made with uninsulated portions, *s*, *s*, in order that the portion, *h*, of the lever in its upward and downward motion against the lever, E, may send intermittent contacts out to line. In order to render the movements of the lever, A, slow, so that the contacts may be of sufficient duration, a spur wheel, *i*, is fixed fast on a spindle, *k*, which is carried in bearings. With this pinion engages a segmental rack, *m*, formed on the end of the lever, A, so that as the lever moves upwards or downwards motion is imparted to the said pinion. On the spindle, *k*, of the pinion, *i*, is also secured an escape wheel, *n*, with the teeth of which engage the pallets of an anchor, *o*, pivotted at *p*; the anchor carries a pendulum, *q*, the bob, *r*, of which may be adjusted in position so as to vary the velocity of motion of the escapement as required.

2526. "Railway signals." ERNEST ALFRED SULLIVAN. Dated June 22nd. 6d. The object of this invention is to produce an audible signal to be used on railways, more especially in foggy weather, or at such times as the ordinary semaphore signals cannot be readily seen. Alongside one rail of the track is

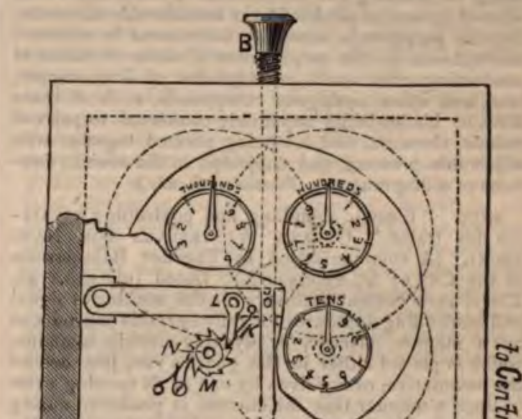
placed a length of iron, by preference, stout angle iron, of such a length that the second wheel on that side of an engine or other vehicle may rest upon it before the first one leaves it, so that once pushed down it may



remain down while the train passes and produce only one sound. This length of iron or side rail is so arranged that one end at least of it shall be capable of rising and falling, the other end being pivotted. In the figures, A is the ordinary rail and B the side rail, placed outside the track. B^1 is a spring for holding up the side rail, B. D is a gong, H is a striking lever with a head, H^1, pivotted at H^2, and with its shorter end working in the bracket, B^3, attached to the side rail, B. A passing wheel necessarily depresses the side rail, B, and thereby forces down the short end of striking lever, H, and raises the head, H^1, and sounds the gong, D. The side rail being long the first wheel will not get clear until another is upon it, and the gong will only be sounded once for each train or single engine passing. An electro-magnet, M, is placed with its poles below and in close proximity to the side rail. When the current from the ordinary apparatus in the signal box is passed through the wires, N and S, the rail is drawn down, so that the wheels of the train cannot depress it and sound the gong; upon the current being discontinued it rises again.

2564. "Galvanic batteries." ROBERT CHAPMAN ANDERSON. Dated June 22rd. 2d. Relates to improvements in that class of galvanic batteries known as the "Daniell battery," the object of the improvements being to increase the power and useful effect of such batteries and to prevent the deposit of copper on the zinc element. The negative element is immersed in oxalate of copper dissolved in muriatic acid more or less diluted according to the strength required. In order to prevent the deposit of copper on the zinc or positive element two porous pots are used (instead of one only) placed one within the other, with an intervening space filled with a solution which will act as a good conductor of electricity, and in this solution are placed metallic iron or other metal which will precipitate copper from its solution, the zinc element being placed in the inner porous pot. (*Provisional only.*)

2643. "Registering apparatus for telephones." JOHN HENRY JOHNSON. (A communication from abroad by Charles James Bell and Sumner Tainter, of the United States of America.) Dated June 20th. 8d. Relates to apparatus for registering the number of times which the several telephones in a telephone system or exchange, comprising a number of stations or subscribers' offices connected with a central office, have been used. The figure illustrates the combination of the telephone call registers with the usual appointments of a telephone station. B, the push knob or key used for calling the central office; C, the call bell by which a subscriber is called, and D, the telephone and transmitter arranged in any convenient or suitable manner. In the telephone system here indicated a galvanic battery at the central office is placed in circuit with the line and instruments shown in the diagram. The depression of the push knob or key, B, breaks the circuit by separating the contact pieces, E, F, thereby



causing a signal at the central office. The push knob, B, is attached at the point, G, to the actuating lever, H, whose fulcrum is at I. The pawl, K, is pivotted to a

lever at L, and turns the ratchet wheel, M, through one tenth part of a revolution each time the push knob, B, is depressed. The ratchet wheel, M, is geared to a train of wheels which move pointers round dials as in an ordinary gas meter, and thus register the number of times the knob, B, has been depressed, and indicates the number of calls made.

2754. "Railway signals." SAINT JOHN VINCENT DAY. (A communication from abroad by Joseph Stokes Williams, of Riverton, New Jersey, United States of America.) Dated July 6th. 2d. Relates, firstly, to the operation and governing of the working of signals, switches, and other moving parts of railways, through the medium of the ignition of explosive materials by electricity. The explosion in a receiver is, according to this part of the invention, caused to create a vacuum to cause moving parts (such as signals, switches, or the devices for testing the position of or holding the switches or signals) to be moved through the creation of the said vacuum. The gas receiver is formed with the opening or openings below the upper surface, so that the gas does not escape thereby. The wire for conducting electricity for exploding the charge is led into the upper part of the gas receiver. (*Provisional only.*)

2826. "Telephones." JOHN IMRAY. (A communication from abroad by Doctor Cornelius Herz, of Paris.) Dated July 9th. 2d. Relates to telephonic instruments and conductors, whereby articulate speech and musical sounds are electrically transmitted from one station to another, the object of the invention being to obtain great distinctness in the sounds, even when they are transmitted over considerable distances. For this purpose the receiving instrument is rendered microphonic by the employment of discs or blades of conducting ores, such as sulphides of iron, copper, lead, and other analogous compounds, each of those discs or blades being separately connected to pairs of voltaic elements, and all being pressed together with adjustable pressure and subjected to the sound vibrations of a diaphragm. (*Provisional only.*)

2835. "Electric signalling and controlling apparatus for trains." GERARD WENZESLAUS VON NAWROCKI. (A communication by Theodor Balukiewicz, of the City of St. Petersburg.) Dated July 9th. 4d. The electric current necessary for the working of signal and controlling apparatus for railway trains is produced by a magnet, electric, or dynamo-electric machine, which is placed either in the guard's van, just behind the locomotive, or is driven by one of its running axles in such a manner that the current is produced during the running of the train, and by suitable circuits in the train and on the line to and fro signals can be given between the officials themselves of the train, between the passengers and officials, as well as from the train to the line and the station for controlling the trains, and *vice versâ*. (*Provisional only.*)

Proceedings of Societies.

THE SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.

AN ordinary general meeting of this Society was held on Thursday, February 10th, Professor CAREY FOSTER, President, in the chair. The minutes of the last general meeting having been read and confirmed, and the list of new and proposed members read, Mr. ALEXANDER J. S. ADAMS read a paper on "Earth Currents."

In a previous paper on the subject, the author had asserted that the *normal* earth current was clearly distinguishable from the variable currents that break in upon it, which have been called "Electric Storms," and that whilst the former appeared to be obedient to some general law, the latter were irregular.

In the paper referred to, the absolute value of the electro-motive force of the normal earth current passing over a wire running parallel to the line of greatest force was stated to rarely exceed a strength equal to five Daniell cells per 150 miles; but, from a careful daily record extending over the past two years, it appears that the usual strength of the earth current at the maximum of its ordinary variation rarely exceeds the one-tenth of a milliweber.

The earth is essentially an electrified sphere, its electricity being liable to disturbance both from within and from without; and it is known that the electrical disturbance of a sphere increases its electricity upon the sides *perpendicular* to the disturbing force, in a similar way to that in which the tides act in reference to the moon.

It appeared that the probable cause of electrical disturbance on the earth was the sun, but investigation showed that this was not the case, as the variations of one day did not agree with those of another.

In 1878 the author commenced an analysis of the observation figures furnished by Mr. James Graves (member of the Society of Telegraphic Engineers) in 1873, from which it seemed probable that the cause was *lunar*, and the variations *lunar*-diurnal. In March and April, 1879, a further systematic course of observation was made on a wire, the ends of which were connected to the earth, one at Cardiff and the other through a sensitive astatic galvanometer at London, every quarter of an hour from March 28th to April 26th, with few exceptions, and the curves of the figures so obtained are as remarkable for their regularity as for the clearness with which they indicate the *lunar* origin of the variations they represent.

It is an important fact that the normal earth current variations of our globe are almost wholly controlled by the moon, for whilst the *magnetic* variations at different localities are more or less complicated, and are influenced apparently by more than one disturbing power, the earth's *electrical* disturbance is not so affected.

If it be taken for granted that, whilst the moon for the time being is stationary, the earth, by her rotation, presents Greenwich during the lunar day successively to all parts of the lunar orbit, then two maximum, two minimum, and four zero, points occur, Greenwich, in about three hours, reaching an electrical zero or point of least current; and three hours later still, a second maximum, but of different kind, is experienced. Another three hours, and a second zero is passed, and again three hours brings Greenwich opposite the moon's nadir, and also to a maximum similar in sign to the first.

Precisely similar features obtain for the other half of the lunar day, and the result of this analysis as regards the current phases of one lunar day is equally true of any other lunar day in the year.

According to the hypothetical arrangement of the earth's electricity, if the moon's age be given with an allowance for retardation, the electric curve which should be forthcoming at a given time for any given spot upon the earth's surface should admit of accurate prediction—a conclusion warranted by the results of one or two experimental trials that have been made.

The *retardation* is a peculiarity clearly indicated by

the variation curves, *as compared with lunar time*, and is a lagging of the electric curve some hours in rear of the moon: thus, Greenwich appears to strike the major pole three or four hours after the moon's precise time of southing for that meridian, and so also as regards all the other electric phases.

Another feature noticeable about the lunar-diurnal variation is an apparent enlargement and contraction of the *major pole curve* in sympathy with the height of the moon above the horizon.

There is also an indication that a similar expansion arises in connection with the age of the moon generally.

The *direction* and flow of the earth current have not been yet satisfactorily accounted for. It is a curious fact, however, that if the earth-current electro-motive forces be supposed to revolve about the *electric-perpendicular*, as an axis, in a *contrary* direction to the earth's rotation, and take the mean of the two, a line of directive influence for the earth current is obtained, agreeing with that derived by observation.

One of the most important results of these investigations is the agreement apparent between the earth-current and the *magnetic* lunar-diurnal variations.

In the case of each of the elements we find a double progression in each lunar day.

The declination has two easterly and two westerly maxima, and the inclination and total force have likewise two maxima and two minima in the same interval, the variation in each case passing zero four times during the lunar day.

From the evidence, the author argued that it is established that the motions of the true earth current constitute a series of tidal ebb and flow very similar to that of the waters of our globe; the chief difference being that, whereas in the case of the ocean there occur *two* flows and ebbs in each lunar day, with the earth's electricity there are *four*—a dissimilarity, however, that may yet prove to be more apparent than real.

In the discussion which followed the reading of Mr. Adams' paper,

Professor ADAMS stated that he hesitated to accept the theory that the distribution of static electricity at different portions of the globe, as would be caused by the moon's influence, could cause currents. Rowland proved that it required motion of the static electricity to cause a current. With regard to the retardation observed in the current beyond the period of the moon's phases, it had been observed that the magnetic changes took place instantaneously all over the globe, as observations had exactly proved. The cause of the currents is probably direct magnetic disturbances and is due to the action of the moon on the solid crust of the earth, this produces electrical tides like ordinary tides.

Mr. SAUNDERS stated that he had made numerous observations on earth currents since 1858, the results of which he had not fully worked out, but he would present the papers to the Society for investigation.

Mr. ELLIS said that magnetic observations do not show lunar curves unless the results of irregular disturbances are eliminated, as has been done by Sir Edward Sabine. The number of irregular observations it is necessary to exclude is about one-seventh of the whole. He thought that if Mr. Adams excluded some of the more irregular observations he might get a closer agreement with the lunar curves.

Mr. WOLLASTON stated that he had commenced observations on earth currents, in conjunction with Mr. Barlow, as early as 1846. When the Dover-Calais cable was first laid he made a series of observations, which he subsequently found agreed *exactly* with the ebb and flow of the tide. He stated that the results had been predicted by Faraday. The currents observed, he considered, were purely due to the mechanical action of the tide. A further series of experiments made on a cable across the Thames confirmed this view, as the current in the wire increased or changed its direction exactly as the tide in the river rose and fell. A retardation was noticed, which he accounted for on the supposition that the upper portion of the water did not flow synchronously with the lower layers. He thought that the currents observed by Mr. Adams on the London-Cardiff wire were generated by the tide in the river Severn, through which a cable ran which formed part of the route of the circuit.

Professor PERRY pointed out that the rotation of a sphere charged with static electricity would produce a current.

The discussion was then adjourned.

City Notes.

Old Broad Street, February 11, 1881.

ANGLO-AMERICAN TELEGRAPH COMPANY (LIMITED).—The ordinary half-yearly meeting of the shareholders of this Company was held on February 4th, at the City Terminus Hotel. Visct. Monck presided. The report stated that the total receipts from the 1st July to the 31st December, 1880, including a balance of £1,187 7s. brought over from the last account, amounted to £220,910 11s. 3d. The traffic receipts showed a decrease of £170,166, as compared with the corresponding period last year, caused by the competitive tariff in force during the greater part of the six months. The total expenses of the half-year, including repair of cable, income tax, &c., as shown by the revenue account, amounted to £58,344 4s. 5d. The directors, under the powers conferred upon them by the articles of association, had, before declaring the net profits, set apart the sum of £75,000 to the renewal fund, leaving an available balance of £87,566 6s. 10d. Interim dividends of 10s. per cent. on the ordinary stock, and £1 per cent. on the preferred stock, free of income tax, were declared on the 8th October, and paid on the 15th November last, absorbing £35,000, leaving a balance of £52,566 6s. 10d., out of which the directors recommended the proprietors to declare final dividends, free of income tax, of 15s. per cent. on the ordinary stock, £1 per cent. on the preferred stock, and 10s. per cent. on the deferred stock, amounting altogether to £52,500, making a total distribution for the year ended the 31st December, 1880, of 3¼ per cent. upon the ordinary stock, 6 per cent. upon the preferred stock, and ½ per cent. on the deferred stock, leaving a balance of £66 6s. 10d. to be carried forward to the next account. After the declaration, but before the payment of the interim dividend, a holder of £50 of deferred stock, whose name appeared on the register for the first time on the 17th October, served the directors with a writ, to restrain them from paying dividends "without having assets to represent capital," and notice was given that if any dividend were paid after the service of the writ, the plaintiff would seek to make the directors personally liable for repayment of the amount to the Company. Hence the declaration of the dividend recommended is dependent upon the result of legal proceedings. The chairman, in moving the adoption of the report, stated that the dividend would be paid as soon as the directors had obtained a decision that they could do so without incurring personal liability, and he did not think that the

payment would be long deferred. An action against the Company had been taken by a gentleman who had a holding of the value of £16 only. It was an extraordinary state of the law that allowed a company to be hung up for several months by persons in such a position. But their Company was not singular in that respect; for the same thing could be done in connection with the Bank of England, and therefore he considered that the law should in some way protect them from such attacks. Owing to a contest with a French company they had had to reduce their tariff; but still there were no reasons for despondency as to the future. In the last year a cable had been successfully laid, and that and the other two cables were in admirable order. Lord Monck then moved the adoption of the report. Mr. Robert Grimston seconded the motion; to which an amendment was proposed to the effect that the dividends be paid, and that the directors be indemnified from personal liability. The amendment, however, was not agreed to; and the report having been approved, the usual votes of thanks concluded the meeting.

THE INDIA-RUBBER, GUTTA-PERCHA, AND TELEGRAPH WORKS COMPANY (LIMITED).—The directors' report for the year ending December 31st, 1880, states that the net profit on the Company's business for the past year, as shown in the accounts, is £67,227 19s. 9d. Adding £4,278 3s. 11d. brought forward from 1879, and £774 profit on securities realised, and deducting £15,600 interim dividend paid in August, there remains a disposable balance of £56,680 3s. 8d. Of this balance the directors have added £25,000 to the reserve fund, raising it to £75,000; and they recommend the distribution of £23,400 in dividend for the last half-year, being at the rate of 15 per cent. per annum, free of income tax, carrying forward £8,280 3s. 8d. to the credit of the current year. The past year's sales, both in general manufactures and in the cable department, have considerably exceeded those of 1879. A contract with the Mexican Telegraph Company of New York for the manufacture and laying of 525 miles of cable is in course of execution. Mr. Henderson, who retires by rotation, offers himself for re-election as a director.

At the meeting held at the City Terminus Hotel on February 9th, under the presidency of Mr. George Henderson, the chairman, in moving the adoption of the report, said that the general business had so materially increased that new buildings had had to be erected at Silvertown and additions made to the machinery, but no expense had been incurred which had not been absolutely essential. The *Dacia* and *International* were at present employed in laying cables in the Gulf of Mexico, and the shareholders would be glad to hear that they had already successfully accomplished more than half their work. After the accounts had been passed a suggestion would be made that for the present year, subject to revision by the shareholders in general meeting, the directors' remuneration should be £2,000 per annum; and that whenever the shareholders received a dividend of not less than 10 per cent. the directors should be entitled to an additional remuneration of 10 per cent. on any profits earned in excess of the sum required for payment of the 10 per cent. dividend, but in no case should their remuneration exceed the sum of £5,000. The resolution adopting the report and declaring a dividend at the rate of 15 cent. per annum, free of income tax, was then carried unanimously. On the motion of Mr. Hanson, seconded by Mr. Horne, it was resolved that the remuneration of the directors should be fixed as suggested in the chairman's speech. Among the other business transacted was the re-election of Mr. George Henderson as one of the directors, and the re-election of the auditors, Messrs. J. Weise and James Cowen; whilst expression was given to the satisfaction of the shareholders at the prosperous condition of the Company's affairs, by passing special votes of thanks to the chairman, to the directors, to Mr. Gray (the manager), and the officials of the Company.

COMPAGNIE DE TÉLÉGRAPHIE SOUS-MARINE DE L'AMÉRIQUE CENTRALE.—This Company has been formed, with a capital of £120,000 in £20 shares, the prospectus states, to connect all Central America with the United States and Europe, by means of a cable (with its tributary land lines) to be laid from Belize (British Honduras) to the Spanish Island of Cuba.

SIR JAMES CARMICHAEL, the chairman of the Submarine Telegraph Company is, we notice, one of the provisional directors; also, that the probable dividend to shareholders is *estimated* at 25 per cent.

THE BRAZILIAN SUBMARINE TELEGRAPH COMPANY having ascertained that messages for South America suffer a delay of two or three days in passing through Spain and Portugal, inform senders that telegrams can be directed *via* Malta, Bona, and Gibraltar, whereby the delay is avoided. The additional charge by this route is 10d. per word.

MR. HENRY COOKE has retired from the board, and Mr. D. H. Goodsall has joined the direction of the Western and Brazilian Telegraph Company (Limited).

THE WESTERN AND BRAZILIAN TELEGRAPH COMPANY notify the interruption of their Rio Grande do Sul, Monte Video section.

The following are the final quotations of telegraphs for the 11th inst.:—Anglo-American, Limited, 59¼-59¾; Ditto, Preferred, 87½-88½; Ditto, Deferred, 31½-32; Black Sea, Limited,——; Brazilian Submarine, Limited, 9⅞-10⅛; Cuba, Limited, 8½-9; Cuba, Limited, 10 per cent. Preference, 16-16½; Direct Spanish, Limited, 3-3½; Direct Spanish, 10 per cent. Preference, 13-13½; Direct United States Cable, Limited, 1877, 10⅞-11⅛; Scrip of Debentures, 101-103; Eastern, Limited, 9½-9¾; Eastern 6 per cent. Preference, 12¼-12¾; Eastern, 6 per cent. Debentures, repayable October, 1883, 102-106; Eastern 5 per cent. Debentures, repayable August, 1887, 100-103; Eastern, 5 per cent., repayable Aug., 1899, 101-104; Eastern Extension, Australasian and China, Limited, 10-10¼; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 107-110; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 104-106; Ditto, registered, repayable 1900, 104-106; Ditto, 5 per cent. Debenture, 1890, 102-104; Eastern and South African, Limited, 5 per cent. Mortgage Debentures, redeemable 1900, 101-103; Ditto, ditto, to bearer, 101-103; German Union Telegraph and Trust, 9¾-10¼; Globe Telegraph and Trust, Limited, 6⅜-6⅝; Globe, 6 per cent. Preference, 12-12¼; Great Northern, 10⅞-11⅛; 5 per cent. Debentures, 102-105; Indo-European, Limited, 26½-27½; London Platino-Brazilian, Limited, 5½-6; Mediterranean Extension, Limited, 2¾-3¼; Mediterranean Extension, 8 per cent. Preference, 10¾-11¼; Reuter's Limited, 10¾-11¼; Submarine, 267-272; Submarine Scrip, 2½-2¾; Submarine Cables Trust, 99-102; West Coast of America, Limited, 4-4½; West India and Panama, Limited, 1½-1¾; Ditto, 6 per cent. First Preference, 6½-7; Ditto, ditto, Second Preference, 5½-6; Western and Brazilian, Limited, 7¾-8; Ditto, 6 per cent. Debentures "A," 103-107; Ditto, ditto, ditto, "B," 98-102; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 122-127; Ditto, 6 per cent. Sterling Bonds, 104-107; Telegraph Construction and Maintenance, Limited, 36½-37; Ditto, 6 per cent. Bonds, 104-107; Ditto, Second Bonus Trust Certificates. 3½-3¾; India Rubber Company, 18½-19; Ditto, 6 per cent. Debenture, 107-109.

THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. IX.—No. 194.

HEINRICHS' DYNAMO-ELECTRIC GENERATOR AND SYSTEM OF ELECTRIC LIGHTING.

THE discovery of the application of an annular armature for electric generators made by Dr. Antonio Paccinotti of Florence in 1860, and independently reinvented in a modified form by M. Gramme of Paris ten years later on, gave a great impulse to the general application of electricity for lighting purposes, transmission of motive power, electroplating, &c., &c. In consequence of this the minds of most of our electrical inventors have been led to modify the form of the ring armature so as to obtain from it better results in the production of electric currents. We have shown many forms of ring armature machines in our columns, but we find that but little credit has been accorded to Dr. Paccinotti for the originality of his invention, notwithstanding that a working model of small size of the Paccinotti Generator was made, and the same well described in *Il Nuovo Cimento.** Many existing machines are merely modifications of the Paccinotti, as, for instance, the Gramme, the Hefner-Alteneck (Siemens), the Lontin (excitor), the Schuckert, the Brush, and the latest, that of Mr. C. F. Heinrichs, which, from the results obtained with the first generator made, seems to be one of the most efficient forms.

We described in November last the principles and forms of the different ring armatures, also the methods of winding the insulated conducting wires thereon, and also the form and position of the inducing magnets. We showed, by comparing the Heinrichs ring armature with the others, that it possessed a most advantageous form for the production of currents, and from the results actually obtained with it, his theory of the generation of currents on a ring armature seems to be proved correct.

The main points we observed in Heinrichs' theory were : *that the insulated conducting wire which surrounds the inner portion of the ring armature is out of the influence of the inducing magnets; that the latter take the greatest part in the generation of currents in the former; that the ring core when in action has throughout its greatest length on the inner surface a reversed magnetic polarity to that on the outer surface; the inner reversed polarity will give an impulse to the generation of current in the insulated conducting wire surrounding the inner surface of the ring core, in an opposing direction to the main currents.*

By considering these points of his theory we must say that his channelled ring armature, an outcome of his theory, is the best improvement yet made on the Paccinotti armature, since it obviates all the disadvantages of the other ring forms; besides, with its surrounding inducing magnets it utilises the greatest length possible of the insulated conducting wire for the generation of electric currents.

Mr. Heinrichs obtains three and four lights, of 1,800 to 2,000 candle-power, with 900 revolutions per minute of his armature, which is slightly larger than the one which Gramme employs for his single light generator. In fig. 1 we show a general view of Heinrichs' dynamo machine, ⅙th of the full size, from which cannot be seen the main differences of this machine from others already so familiar to us, the channelled ring armature being, with great advantage, entirely inclosed by the inducing magnets. The brushes and terminals being very suitably arranged.*

The generator is certainly very compact and small for a four-light machine, and promises well. In fig. 2 we show a cross section of the generator, from which we can see the channelled ring armature as fitted and held to the shaft; all parts are so arranged as to be easily changed. The channelled ring core is made out of a bundle of thick iron wire formed upon a metal casing, *g*. Around the core, r_1 r_1, is wound the insulated conducting wire, *w*, in 36 sections; these overlie the outer surface of the core only, and by crossing the channel of the core the inner surface of the latter (when becoming magnetised) has no influence whatever upon that very short and nearly useless portion of the insulated conducting wire which crosses the channel. The 36 sections of insulated conducting wires are connected with each other continuously by 36 commutator plates, e^1 to e^{36}, in a similar manner as in the Paccinotti generator. Upon the shaft, *s*, is fixed the boss, *a*, with its six sets of spoke-like extensions, upon which the ring core is fitted freely and held securely by six metal holders, *a*, *a*. On those portions of the ring core which rest upon the spokes no wire can be wound, and here the air can freely pass into the channel and aid in preventing the accumulation of heat. The entire outer surface of the ring armature is surrounded by the two sets

* British Museum Library.

* The best position of the brushes on the commutator is a very little above the neutral line of the generator, and hardly any sparks are produced when in action; this is claimed as a further proof of the efficiency of the generator.

FIG. 1.

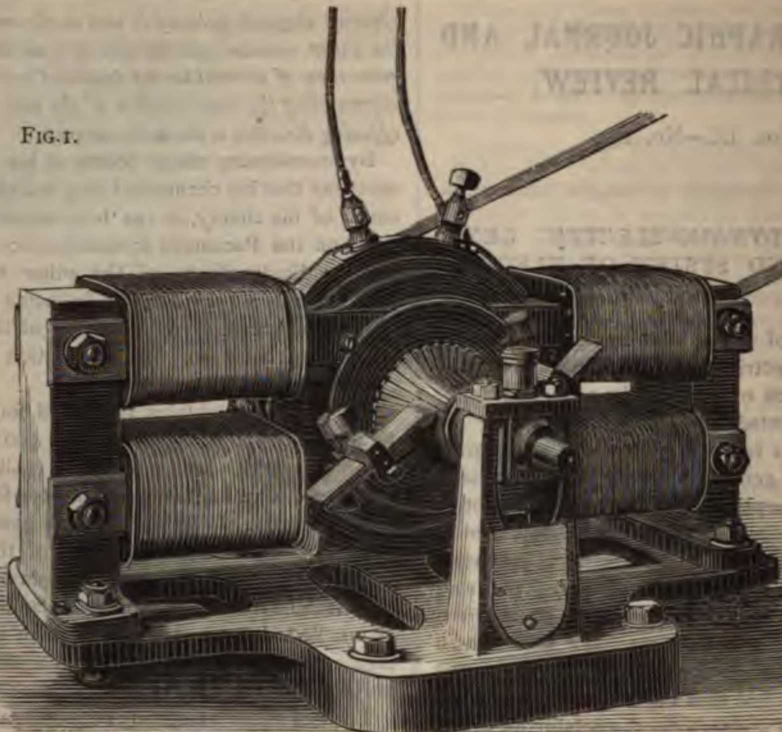
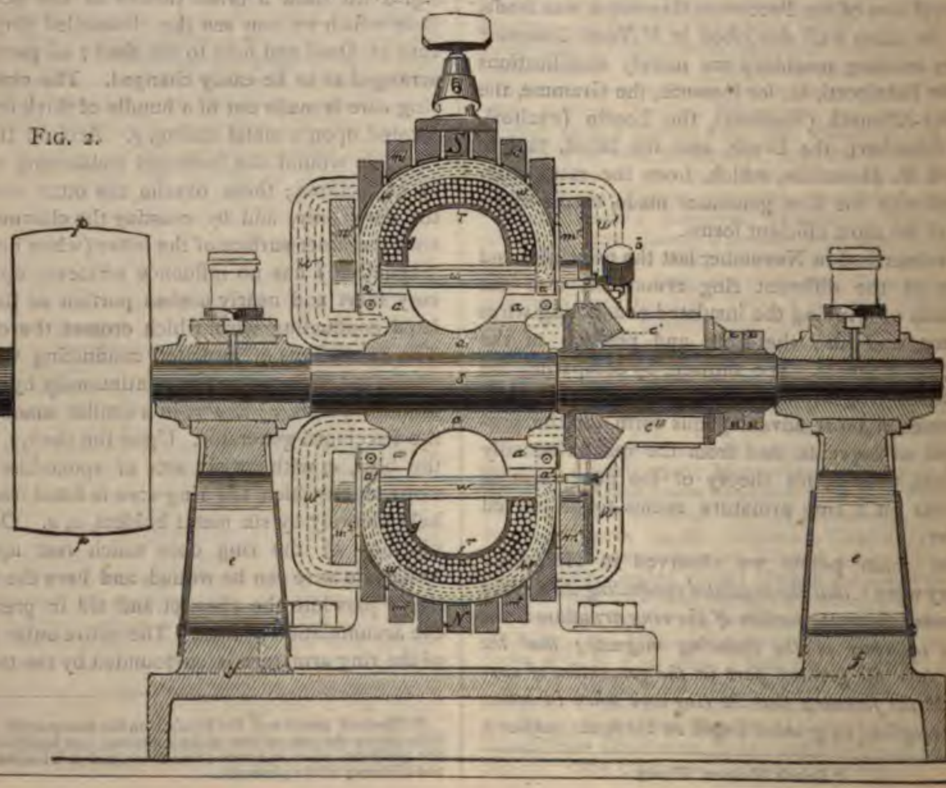


FIG. 2.



of electric inducing magnets, N and S, each set of which are made out of 9 plates, m^1, m^1, S, m^1, m^1, and m^2, m^2, N, m^2, m^2. When the ring armature, r_1 r_{11}, as fitted to the shaft, s, is rotated within the fields of the inducing magnets, N and S, electric currents will be collected by the brushes, b^1 and b^2, from the commutator, C, and led through the coils of the insulated conducting wire, w^1 w^1 (which surrounds and excites the inducing magnets), to the terminals, and thence to the lamps or places where required. As can be seen, the main difference of this generator lies in the channelled form of the ring armature, which seems to be of great value. It is stated that with this generator Mr. Heinrichs maintains three lights of 2,000 candle-power, with an expenditure of about four to five horse-power, and 800 to 900 revolutions per minute of the armature (four lights are maintained with 1,100 revolutions per minute); but Mr. Heinrichs undertakes to make the generators, without enlarging the size, to supply four lights with the same number of revolutions of the armature, and the same horse-power as the three lights now require.

The figures of light and horse-power are roughly given by comparing the light-power of this system with the figures given by other lights now before the public. Mr. Heinrichs made some experiments with his new light and a Gramme generator (made in Stockport) before his present generator was completed, and he states that he uses the same pressure of steam and the same engine for his three-light as he had to use for the above one-light generator. The number of revolutions of the armature of the latter was above 1,000.

In fig. 3 we show a perspective view of the channelled ring armature, with only a few turns of wire, showing the wire crossing the channel. This view shows the ring core of a large 20-light generator, and where the former is split, which prevents the generation of currents in the same, and also facilitates and quickens the demagnetisation of the mass of iron. Splitting the iron ring is mostly done in large generators, the Brush, for instance. In the Siemens the small cylinder armature is split several times.

In the specification of his patent, Mr. Heinrichs describes many different modifications of his principle of channelled ring armatures and surrounding inducing magnets, of which we have shown the most developed form by fig. 11 in the article on the different armatures, and in which the ring armature is nearly circular in cross-section, and the surrounding inducing magnets of the same form. With this shape greater efficiency ought to be obtainable; but we think the manufacturing difficulties must also be greater, which has led Mr. Heinrichs to adopt the present form.

Having described his generator, we come now to his system of electric lights, shown in figs. 4, 5, 6, and 7, and which are original—not alone in the circular form of the carbon pencils, but also the method by which the arc is maintained.

As is well known, we have had up to now only one electric candle (and its modifications), the Jablochkoff, where the light is maintained without regulating mechanism, and the distance of the arc kept constant. The short burning time of the Jablochkoff candle (only two hours per candle), and the fact that they are only available with alternating currents, is a great drawback to their general and sole application.

All other lamps have some more or less complicated mechanism or arrangements for the feed of the carbons, which are liable to fail: in one lamp differential shunt coils, in combination with a pendulum, are employed for regulating the feed of the carbons. In another, differential shunt-coils, in combination with a glycerine stuffing box, are employed for regulating the feed of the carbons, for a time, of a single lamp not exceeding eight hours; a slight difference in the speed of the motive power produces, nevertheless, irregularities in the lights—the lights extinguish, or the carbon points come in contact while burning, so that some lamps have then to be lowered, and the carbons withdrawn by hand; while in other lamps the carbons are allowed to burn themselves free, which takes several minutes. In all these and other systems straight carbon pencils have been employed.

Further disadvantages of these lamps are that the racks or bars which guide the straight carbons must be longer than the carbons, which will not allow a great length of the latter to be employed. The racks and bars are in gearing with the regulating mechanism, into which they carry the dust of the carbons and thus cause irregularity and stoppage of the lights.

In 1813 Sir Humphrey Davy used in his electric lamps two straight carbon pencils placed vertically above each other, and since that time all lamp improvements have been all more or less in the same direction. In Mr. Heinrichs' lamp the two sets of carbons cross each other, and the arc is formed and maintained at their crossing point.

Mr. Heinrichs patented and made nearly three years ago a very original regulator with circular carbons*, from which time also dates his priority of the application of circular carbon pencils. The regulator did not satisfy Mr. Heinrichs, and knowing the *disadvantages of any regulating mechanism*, he experimented further with a rough model, which constitutes a simple and novel electric candle lamp, *i.e., without any mechanism for regulating the feed of the carbons;* this is shown in a general view by fig. 5, and inclosed in a suitable shade, by fig. 6; this lamp has a burning time of from 20 to 50 hours; the size of the circular carbon pencils is from eight to twelve inches diameter. The distance of the arc is constant and maintained at the same point. As is known, the arc travels through a distance of six inches in the Jablochkoff candle and the Brush lamp.

In Heinrichs' candle no mechanism is below the arc, therefore no shadow results from them. The arc has a very low resistance on account of the four pencils leading the current to the arc; this is of great advantage for subdividing the current, and as this lamp with its long burning time also occupies little space, it must prove to be one of the electric lights of large illuminating power.

The length of the arc is set to the required length to suit the quantity and electromotive force of the current; under these conditions it is impossible for the arc to become any longer, as will be seen in fig. 5; the thickness of the carbon pencils limits the lengthening of the arc. This feature obviates the

* TELEGRAPHIC JOURNAL, Sept. 15th, 1879, fig. 4.

FIG 4.

FIG. 5.

FIG. 6.

FIG. 3.

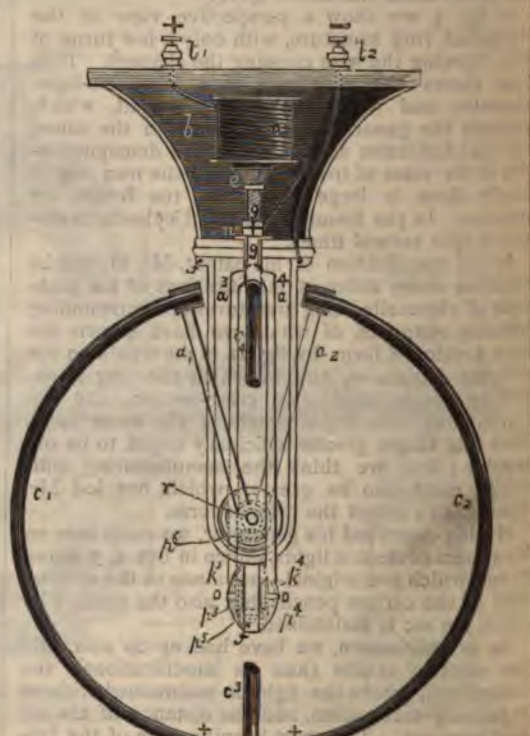


FIG. 7.

employment of shunt-coils, without which other lamps, if several are put in a continuous current circuit, cannot maintain the arc. In some lamps a shunt-coil of 450 ohms is employed, which not only makes the lamp more expensive but is also liable to be destroyed.

In fig. 7 we show the mechanical details of this candle lamp, by which the general view given in fig. 5 can be better understood. The two positive circular carbon pencils, c^1 c^2, are held at one extremity by the two metal arms, a^1 a^2; the other ends are kept in constant contact with each other by the weight of the two arms. The two negative circular carbon pencils, c^3 c^4, are held and kept in constant contact by the two metal arms, a^3 a^4; each set of carbon-holder arms has a common fulcrum, and the two are kept in gearing with each other in the following manner: to the arms, a^1 and a^2, are fixed the pinions, p^1 and p^2, between which two gears the pinion, p^6, and to the arms, a^3 and a^4, is fixed the pinion, p^3 and p^4, between which gears the pinion, p^5. This prevents the arms from falling unequally, and will maintain the contact points of the carbons exactly at the crossing point.

The negative set of carbon-holder arms, a^3 and a^4, have their common fulcrum in the frame, $f f$, which is fixed insulated to the lamp base, b. The positive set of carbon-holder arms, a^1 and a^1, have their common fulcrum in the movable frame, g (which enters the base, b), to which is fixed the armature, e. This armature, when attracted by the magnet, m, will lift the positive set of carbons, c^1 and c^2, from the negative set of carbons as follows:—When no current passes through the lamp both set of carbons rest in contact with each other at the crossing point. When a current is sent through the lamp in order to start the light, the positive current enters the terminal, t^1, passes to the lamp magnet, m, into the metal boss, n, which is in contact with the movable base, g, thence to the metal arms, a^1 a^2, into the two carbons, c^1 and c^2.

The negative current enters the terminal, t^2, thence to the frame, $f f$, into the metal arm, a^3 a^4, to the two carbons, c^3 c^4, when the magnet, m, will attract the armature, e, which will lift the positive set of carbons a sufficient distance away from the negative set of carbons, when the arc will be formed and maintained as long as the current passes through the lamp at the crossing point of the two set of circular carbon pencils. Each set of carbons keep falling together (by the weight of the respective metal arms which guide the carbons) as the carbons are consumed. As seen, the lamp is perfectly simple: no chains, cords, or racks are employed. The simple system of pinion is thoroughly covered by metal covers; thus we have no parts in this lamp liable to come out of order by usual treatment, nor any adjustment or regulation required after the lamp has been put into its circuits.

THE TELEPHONIC SYSTEMS OF DR. CORNELIUS HERZ.

By TH. DU MONCEL.

IN spite of the progress accomplished in telephony since the invention was first brought out, there has not yet been produced a telephone which will reproduce speech at a great distance sufficiently clearly and strongly to satisfy the public. One is convinced of this by the fact that certain discontented subscribers to telephonic exchanges declare that they cannot hear at all. Certainly this defect of understanding is often due to a defect in the organ of hearing as regards telephonic sounds, and above all to a defective education of the ear for this kind of correspondence; but it must also be due in a great measure to causes which extinguish and confuse sounds telephonically reproduced, above all when they are transmitted through a telegraph line, subject at all times to accidental currents of all kinds, such as earth currents, induced currents, atmospheric currents, &c.

In order to overcome these currents, on a rather long line, it is necessary that the undulatory currents transmitted should have a certain energy, and it has been necessary to employ battery telephones; but, as the variations of resistance determined by the transmitting apparatus in order to furnish these undulatory currents are always sufficiently feeble relative to the resistance of the entire line, the inflexions of the electric waves are not sufficiently characterised to furnish all the small sinuosities which correspond to articulate sounds; they are effaced more or less by the resistance of the line, and are mutilated by the accidental electric currents which pass over them. In order to avoid this inconvenience, it is necessary to solve two problems: 1st, to increase considerably the amplitude of the electrical vibrations without its being necessary to increase the power of the voice, and 2nd to do this in such a manner that the electric currents foreign to those directly transmitted may not traverse the telephonic circuit. These are the two problems which have been solved by Dr. Herz in the telephonic systems of which we have already spoken, but which we shall completely describe.

In order to obtain these reinforcements of the electric waves several means can be employed: the first is the system of derivation, which was referred to in a previous article; the second is a microphonic system, presenting a great number of partially conducting points, but arranged in such a manner as not to furnish too high a resistance; the third, in the case of the employment of induced undulatory currents, transmitted by an induction coil, is a system able to augment the amplitude of the electric waves by the prolongment of the duration of these induced currents themselves. All these means have been employed and patented by M. Herz, and have furnished good results. As regards the second part of the problem, it has been solved by the means used on submarine cables, that is to say, by the interruption of the circuit itself, and the interposition in the circuit either of condensers, or of diffusers of electric charges, as, for instance, lightning-protectors with points or combs. By the employment as a receiver of a speaking condenser, the problem becomes resolved directly by the introduction of the apparatus itself in the circuit; but by employing ordinary telephones, the introduction of combs or condensers between the apparatus and earth satisfies the desideratum which has been pointed out. It can be understood, in effect, easily, that the interruption of the circuit completely hinders accidental currents from being propagated, or, at least, if they are propagated, they

cannot be of such power as to affect telephonic transmissions. We will now show how some of these systems have been arranged. We will describe later on the others, which are the most important, when the time comes to make them known.

The first system, put to test in the experiments made last autumn between Brest and Penzance, had as a transmitter the apparatus shown in elevation by fig. 1, and in plan by fig. 2; the electrical arrangements being shown by fig. 3. But in order to explain the principle, fig. 4 is given, which represents the whole arrangement with the condenser and comb in circuit. In this figure, the transmitter is represented by the multiple contacts of the microphonic system, and it is, as can be seen, joined up as a derivation from the battery, each cell being connected to a different part of the arrangement. Each of the system of contacts is composed of a plate of carbon, or, better still, of a plate of iron pyrites or pyrolusite, upon which rest points of carbon or pyrites, carried by hinge levers, the pressure of which can be regulated by springs. These levers are mounted on metallic columns, as

FIG. 1.

seen in fig. 1; and, in order to understand better the arrangement, two of these levers are shown as dropped down. The moderately conducting plates are fixed (six in number) on a vibrating disc, which forms the upper part of the apparatus, and are ranged around the centre of this disc, as seen in figs. 2 and 3. It is of the upper part of this disc of which we speak.

Each of the plates of pyrites communicates, as can be seen in figs. 3 and 4, with the plates connecting the elements of the battery, in such a manner that the current emanating from each element traverses each contact, and, as there are two contacts to each plate, the battery should be composed of twelve elements, joined up in series. In order that all these contacts may furnish a continuous connection from one extremity of the chain to the other, and at the same time be able to act independently and distinctly, the points of the contact levers are connected by a branch from one plate to the other, by means of a forked wire conductor, as seen in figs. 3 and 4. A glance at the arrangement will show that the current from the first element to the left of the battery passes directly to earth by passing through the first contact to the left of plate No. 1. The current of the second element passes in like manner to earth by passing through the second contact of the plate No. 1, thence by the first contact. The current from the third element passes first by the plate No. 2, the first contact to the left of this plate, the forked wire of the second contact of the first plate, the two contacts of this plate, and lastly goes to earth; it is the same for all the other elements of the battery. As the first element to the left of the battery corresponds with others to earth, it can be seen that all the individual currents of the elements of the battery have two paths to flow by: the circuit of the transmitter contacts and the circuit of the line. This arrangement has been taken in order to diminish, in a great proportion, the resistance of twelve contacts of the transmitter, which is considerable, and to introduce them on a derivation to earth, in order to amplify the variations of the transmitter resistance. By this arrangement, then, there are two causes of the amplification of the variations: 1st, that which results from the derivation; 2nd, that which results from the increase in the number of contacts; and by the fact of the derivations effected at each element of the battery, the total resistance of the transmitter is thus diminished in a sufficiently great proportion.

In order to be able to judge of the importance of the derivation system under these conditions, we will make a little calculation. We will call b the circuit of the line, a the derivation circuit constituted by the contacts of the transmitter, E the electromotive force of the battery, and r its resistance. According to Ohm's law, the current strength, C, when the transmitter of a resistance, a, is introduced into the circuit, is :—$C = \frac{E}{r + a + b}$, and for this same value of C, in the case where the transmitter constitutes the derivation: $C^1 = \frac{E}{r + \frac{r\,b}{a} + b}$; this last formula only differs from the other by the quantity intermediate between r and b, which is simply a in the first case, and $\frac{r\,b}{a}$ in the second case.

Now, it is easy to see, by the form of these two expressions, that the variations of a will affect much more the value of C in one case than in the other. Suppose, for example, $r = 5$ ohms, $a = 10$ ohms and $b = 100$ ohms: the total resistance, forming the division of E, will be, in the case of the simple circuit, $5 + 10 + 100 = 115$ ohms, and in the case of the derivation, it will be, $5 + \frac{100 \times 5}{10} + 100 = 155$. Now let us admit that, in consequence of a difference of pressure in the contacts, a became reduced to 2 ohms, the resistance in the first case will be changed to 113 ohms, but in the second it will change to 168 ohms. The variation in the intensity of the current in the telephone circuit will be in the first case from 1 to 1·017, and in the second case from 1 to 1·084. We can see, therefore, how much is gained in sensibility by the combination by the derivation system.

In the first experiments made with this system of transmitter between Brest and Penzance, various magnetic telephones were employed as receivers, and experiments were made with and without a

condenser interposed in the line, and also with and without a comb lightning-protector, as shown by fig. 4. The results were already sufficiently satisfactory to encourage one to persevere with the problem; and it was at that time that the results were announced in the different journals, and in *La Lumière Electrique*, on 15th September, 1880.

From a practical point of view, the arrangement indicated by fig. 1 had several inconveniences; it required a very careful adjustment of all the contact levers, and, when an adjustment is necessary in telephonic apparatus, the latter ceases to be of practical value. It was sought, therefore, to remedy this inconvenience; and this was done in an extremely simple manner by means of the apparatus represented in vertical section by fig. 5, and in plan by fig. 6. In this apparatus the contacts are formed of discs of pyrites or other metallic sulphides, and are suspended in pairs, by means of tongues, to a thin wooden board, which serves as a vibrating plate. Under these conditions, the surfaces of contact are sufficiently developed to diminish the resistance of the apparatus; and to insure good contact, weights of lead are attached to each set of discs, as shown in fig. 5. The electrical connections are in other respects effected as shown by fig. 6, and, as regards the rest of the arrangement, it is similar to that in the first system; only, as there are more plates furnished with double contacts, the number of contact couples is twelve instead of six, and the forked connections are effected on an upper and lower disc. Experiment has shown completely that it is possible to simplify this system, and to reduce the number of couples to three. It was with an apparatus of this kind that the decisive experiments were commenced, three months ago, between Orleans, Blois, Tours, Poitiers, Angoulême, and Bordeaux; these led to the important results which have been announced, and in these experiments numerous studies were made with reference to the best arrangement to give to the battery as regards connecting it up to the contacts of the transmitter. Thus, a combination of the cells in series was tried, so that there was at each contact a double element (joined up in quantity), the contacts being all joined up in series. This arrangement had an advantage in certain cases, whilst in others it was the combination by simple elements that answered best. Induction coils were tried in connection with these systems, one for each contact; then the elements of the battery were connected, one to each contact, and passed through the primary circuit of the corresponding bobbin. In this case all the secondary circuits were joined up in quantity, and thus connected to the line and earth. Good results were obtained with this arrangement, but it was too complicated. There were also tried transmitters with three, six, and twelve pairs of contact discs, but always in employing the system of derivation, and with a number of battery elements equal to that of the disc couples, each element was itself composed of two elements joined up for quantity, the whole being joined up in series with derivations to the transmitter between each element or group of elements. As a receiver, magnetic telephones were employed, but also the speaking condenser, and to this subject it will not be uninteresting to point out the various experiments which were made about a year ago with this interesting instrument.

On the 23rd June, 1880, M. Herz, having asked me to assist him at experiments made at the Boulevard Saint-Marcel, my attention was attracted by the fact that a condenser of small dimensions could, under certain conditions, reproduce speech. I can testify to this fact, and I was very much astonished at it; however, when it was shown that the transmitter was interposed on a derivation, and that this transmitter was that represented by fig. 1, and charged by a strong battery, I could understand the reason of the effect; but, on my being asked to keep secret what I had seen, I could not continue my investigations, and I had even forgotten the arrangement of the experiments, when M. Dunand explained to me his system of a speaking condenser, in which he employed a second battery, placed near the condenser, in order to polarise it in a constant manner. I recollect that M. Herz only employed one battery, and I thought I saw a difference in the two systems. However, on consulting the patents of M. Herz, I remarked that, *in consequence of the arrangement of the transmitter in derivation, the condenser employed as a receiver became always charged to the potential of the battery*, and that *the action of the transmitter had no other effect than that of diminishing more or less the potential at the moment of its action, and consequently to reflect by the condenser all the variations of resistance determined by the sonorous waves of the voice.* Fig. 7, extracted from the patent of June 9th of M. Herz, represents in effect the arrangement of the experiment, which can leave no doubt on the subject.

Since the time when I saw the experiments in question, the speaking condenser was experimented with always, and it took some time before the most advantageous arrangement of the battery was found out in order to make the condenser speak strongly. When experiments were made between Brest and Penzance it was tried without yielding satisfactory results; this was not the case between Orleans and Bordeaux; and since this time no efforts were spared to make the arrangement perfect, and the results have been that good work has been obtained on circuits the most difficult for telephonic transmission, but in employing another transmitter, which cannot be described at this moment, and to which the first electric combination has been appropriated in a peculiar manner, susceptible of application to induced currents. It is a result highly important, as has been said at the commencement of the article, that this system presents the extreme advantage of the line being cut, so that accidental and abnormal currents are cut off. We represent the arrangement by fig. 8. Fig. 9 shows an outside view of one of the numerous forms the instrument has assumed.

In the course of the experiments of which we have spoken, condensers of an electrostatic capacity of 5 to 10 microfarads were interposed in the circuit, and also comb lightning-protectors, which are shown by figs. 10 and 11; but the results obtained were not as good as were expected, in consequence of the decrease which their presence produced in the intensity of the transmitted currents; nevertheless, one may judge of the part which they can play in preventing the effects of abnormal and accidental currents. It may be remarked that with the new

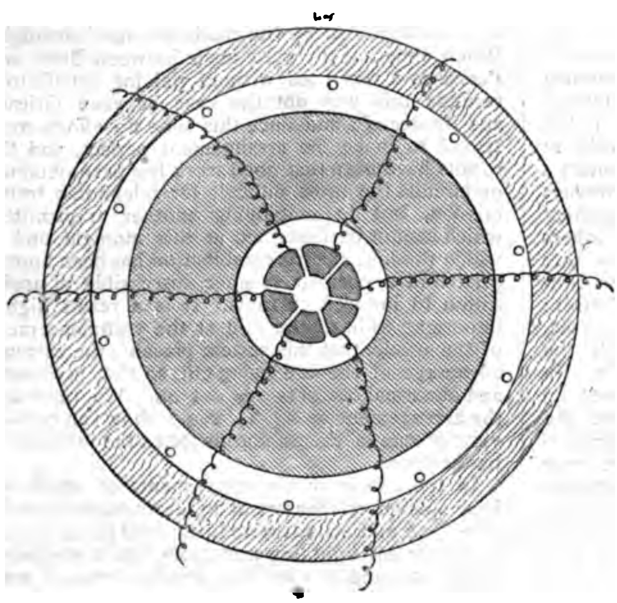


FIG. 2.

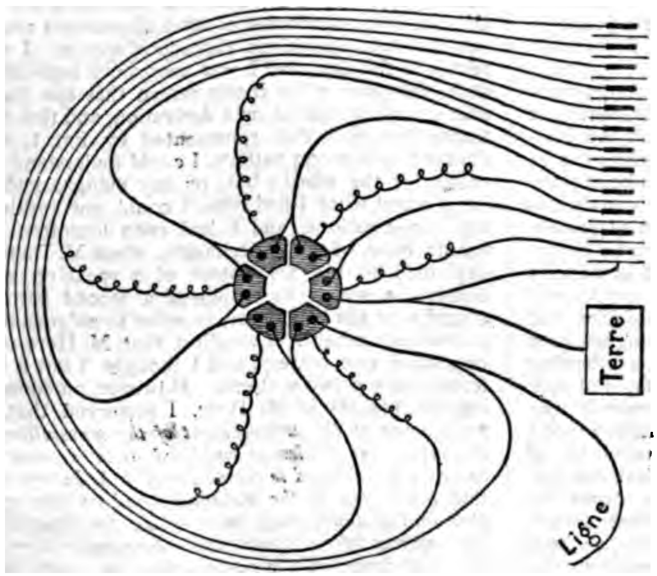


FIG. 3.

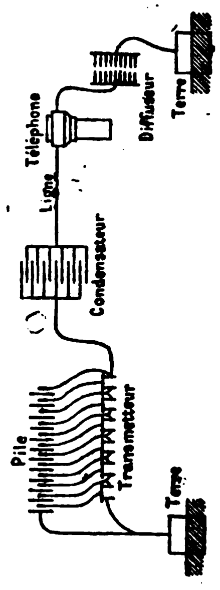


FIG. 4.

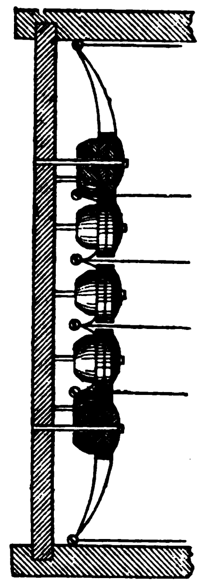
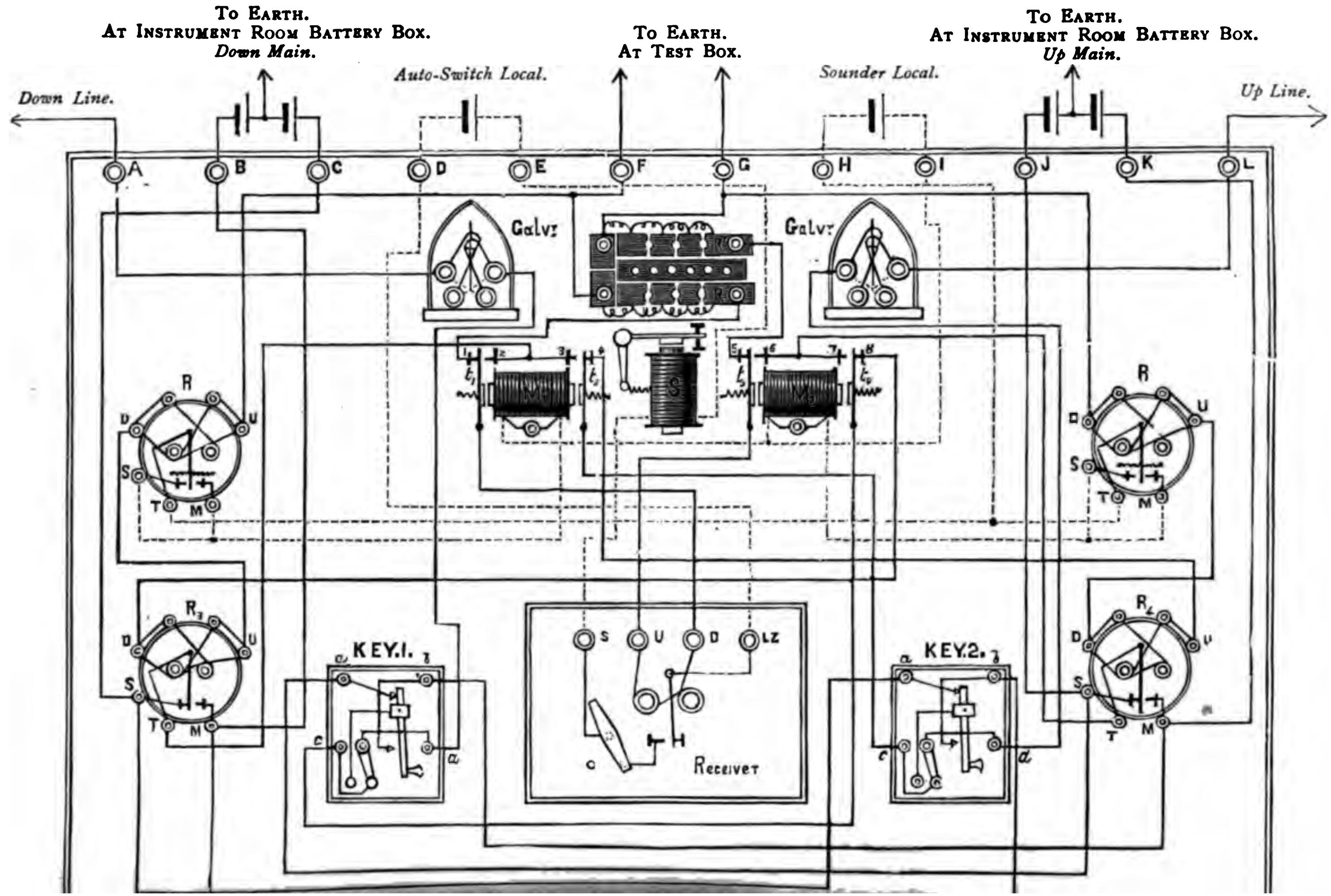


FIG. 5.

AUTOMATIC FAST-SPEED TRANSLATOR.



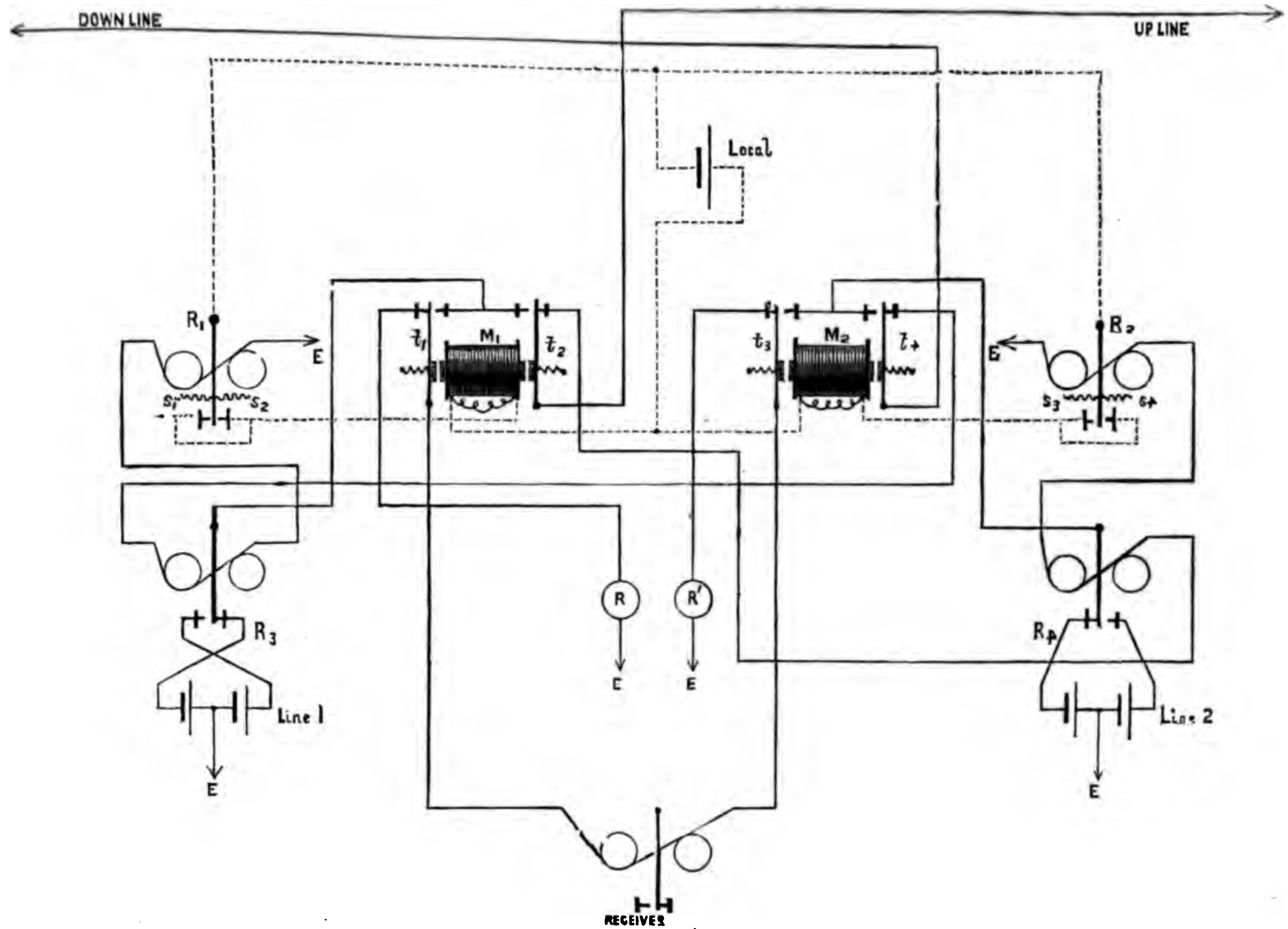

DOWN LINE
UP LINE
Local
R₁
E
S₁
S₂
t₁
M₁
t₂
t₃
M₂
t₄
E
R₂
S₃
S₄
R₃
Line 1
E
R
R′
E
E
R₄
Line 2
E
RECEIVES

FIG. 113.

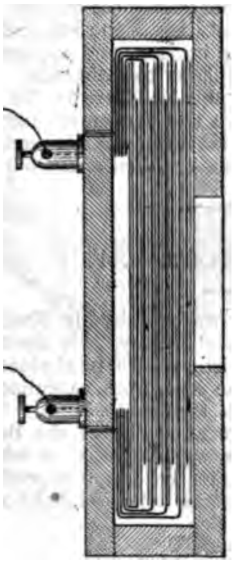


FIG. 8.

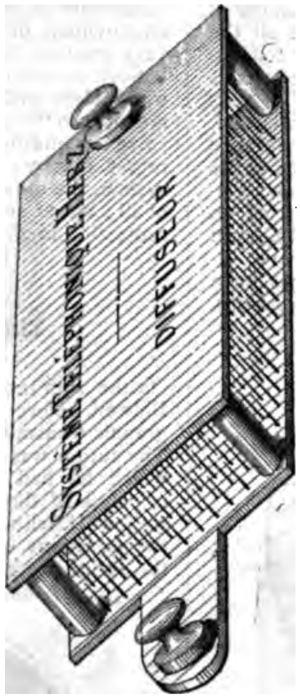


FIG. 10.

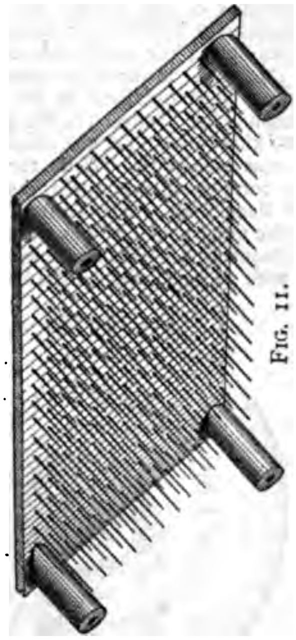


FIG. 11.

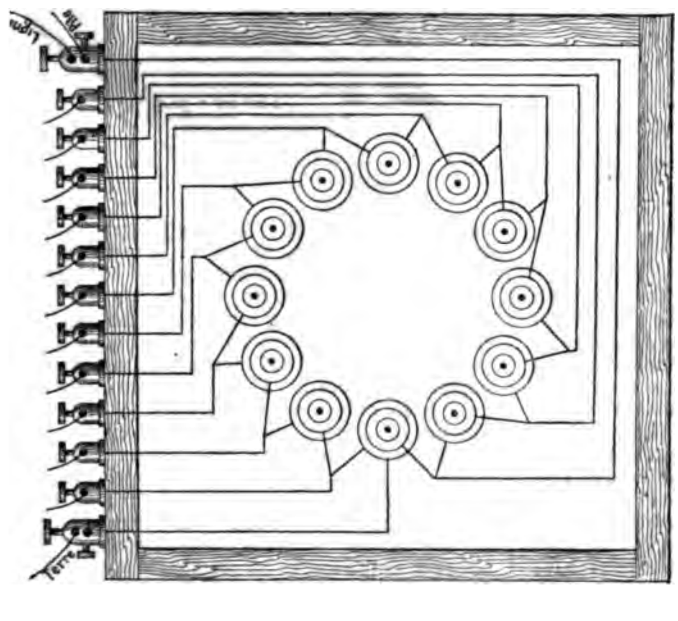


FIG. 6.

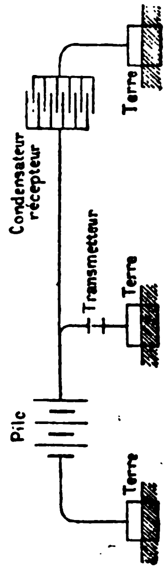


FIG. 7.

[illegible] of which we cannot yet speak. It has been possible to reduce considerably the number of the elements of the battery, and to avoid all the derivations which have been referred to in connection with fig. 1; the amplification of the effects is then produced in another manner. With this system has been obtained, as we have announced, the transmission of speech to the enormous distance of [illegible] kilometres; but the absolute silence of the night was necessary. With three Lelanché elements, correspondence could easily be carried on on the lines from Paris, Tours, Poitiers, &c., even when the neighbouring lines were in full work.

The transmitter with multiple contacts has been tried with success, without the battery derivations,

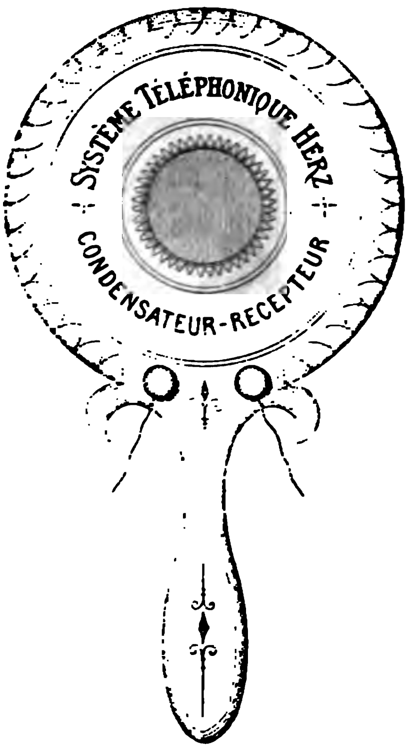


FIG. 9.

by connecting all the contacts together, but by interposing them as a derivation to the earth, as in the other systems. Nevertheless, it is necessary to employ a powerful battery of 32 elements at least (64 elements do not give a much better result); it has been noticed also that the sounds were less clear than with the arrangements which we have previously described. Experiments have also been made with different groupings of the contacts of the transmitter. Thus they have been joined two and two, and derivations only established with the battery at every two. The battery was thus reduced to one half. Equally good results have been obtained with this arrangement; less good, however, than with the arrangement which has been explained.

The speaking condenser has worked very well between Paris and Orleans, and between Paris and Tours. Besides, in Paris itself, several recent remarkable experiments have demonstrated that the employment of the speaking condenser presents very great advantages for telephonic offices.

Such are the experiments tried three months ago by M. Herz on the different lines of the State; they are, as can be seen, very curious, and apparently solve the question of telephony to a distance. We regret that we are not able to describe the last system, the most complete and the most practical of all; but at present the invention has not received protection in all countries.—*La Lumière Electrique.*

TELE-PHOTOGRAPHY.

ON the 26th inst. a paper was read by Mr. Shelford Bidwell, before the Physical Society, "On the telegraphic transmission of pictures of natural objects." The author was led to the idea from experiments which he had made on the photophone. The principle of the arrangement is that of the Bakewell or D'Arlincourt copying telegraph, in which the variations of the current necessary to produce the design are effected by the action of light on a

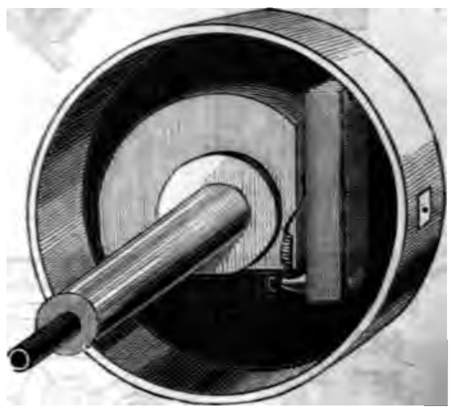


FIG. 1.

selenium cell. In the copying telegraphs referred to, the design is traced out in a series of broken lines of uniform thickness; in Mr. Bidwell's arrangement the varying force of a current produces a corresponding variation in the definition of the lines on the chemically prepared paper, and thereby a more faithful representation of the object copied is produced. The experiments made as yet have been only comparatively rough ones, yet the amount of success obtained was considerable, and would seem to prove that with more perfect apparatus very satisfactory results could be attained.

In the first experiments it was proved that the variation in the resistance of the selenium cell, due to the action of light, could produce distinct changes in the marks on chemically prepared paper. In consequence of the satisfactory results, the apparatus, of which we give an illustration, and for which we are indebted to Mr. Bidwell, was devised.

The transmitting instrument consists of a cylindrical brass box (fig. 1) four inches in diameter and

two inches deep, mounted axially upon a brass spindle seven inches long, and insulated from it by boxwood rings. The spindle is divided in the middle, its two halves being rigidly connected together by an insulating joint of boxwood. One of the projecting ends of the spindle has a screw cut upon it of sixty-four threads to the inch; the other end is left plain. The spindle revolves in two brass bearings, the distance between which is equal to twice

mitter is represented in general view by fig. 1, and in diagram in fig. 5, where H is the hole in the cylinder opposite the selenium cell.

The receiving instrument contains another cylinder similar to that of the transmitter, and mounted upon a similar spindle, which however is not divided nor insulated from the cylinder. An upright pillar, D (figs. 2 and 5), fixed midway between the two bearings, and slightly higher than the cylinder,

SELENIUM CELL.

FIG. 3

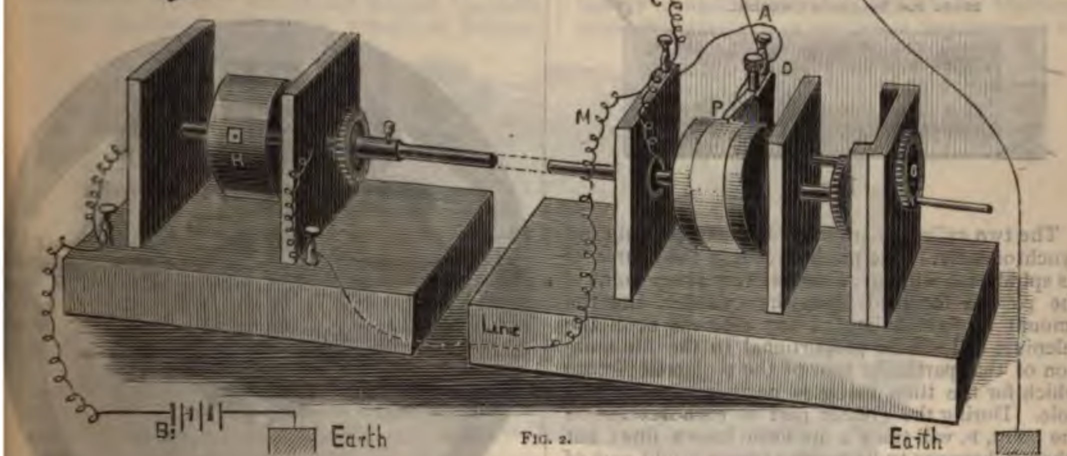



FIG. 2.

FIG. 6.
IMAGE FOCUSSED UPON TRANSMITTER.

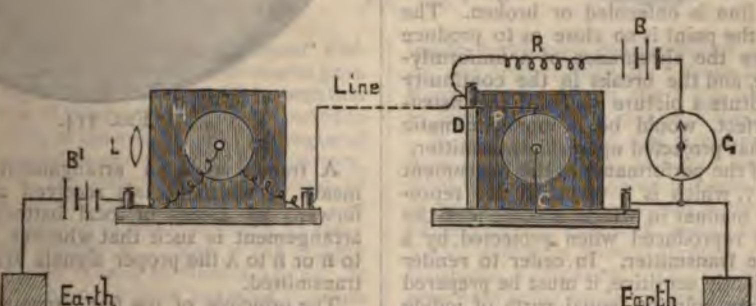


FIG. 5.

FIG. 7.
IMAGE AS REPRODUCED BY RECEIVER.

the length of the cylinder; and one of the bearings has an inside screw corresponding to that upon the spindle. At a point midway between the two ends of the cylinder a hole, H (fig. 2), a quarter of an inch in diameter is drilled, and behind this hole is fixed a selenium cell (figs. 3 and 4), the two terminals of which are connected respectively with the two halves of the spindle. The bearings in which the spindle turns are joined by copper wires to two binding screws on the stand of the instrument. This trans-

carries an elastic brass arm fitted with a platinum point, P, which presses normally upon the surface of the cylinder. To the brass arm a binding screw is attached, and a second binding screw in the stand is joined by a wire to one of the brass bearings.

To prepare the instruments for work they are joined up as shown in figs. 2 and 5, two batteries, B, B_1, a set of resistance coils, R, and a galvanometer, G, being used. The cylinder of the transmitting instru-

ment is brought to its middle position, and a picture not more than two inches square is focussed upon its surface by the lens, L (fig. 5). The pictures upon which the author operated have been mostly simple geometrical designs cut out of tin-foil and projected by a magic lantern. The comparatively large opening, H, is covered with a piece of tin-foil, in which is pricked a hole, which should be only just large enough to allow the instrument to work. The hole is then brought, by turning round the cylinder, to the brightest point of the picture, and a scrap of sensitised paper, in the same condition as that to be used, being placed under the point, P, of the receiver, the resistance, R, is adjusted so as to bring the galvanometer to zero. When this is accomplished, the two cylinders are screwed back as far as they will go, the cylinder of the receiver is covered with sensitised paper, and all is ready to commence operations.

MICA PLATE, WOUND WITH TWO COPPER WIRES READY FOR SELENIUM COATING.

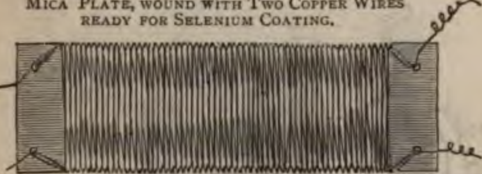


FIG. 4.

The two cylinders are caused to rotate slowly and synchronously. The pin-hole at H in the course of its spiral path will cover successively every point of the picture focussed upon the cylinder, and the amount of light falling at any moment upon the selenium cell will be proportional to the illumination of that particular spot of the projected picture which for the time being is occupied by the pin-hole. During the greater part of each revolution the point, P, will trace a uniform brown line; but when H happens to be passing over a bright part of the picture this line is enfeebled or broken. The spiral traced by the point is so close as to produce at a little distance the appearance of a uniformly-coloured surface, and the breaks in the continuity of the line constitute a picture which, if the instrument were perfect, would be a monochromatic counterpart of that projected upon the transmitter.

An example of the performance of the instrument is shown in fig. 7, which is a very accurate representation of the manner in which a stencil of the form of fig. 6 is reproduced when projected by a lantern upon the transmitter. In order to render the paper sufficiently sensitive, it must be prepared with a very strong solution (equal parts of iodide and water), and when this is used the brown marks disappear completely in less than two hours after their formation. There is little doubt that a solution might be discovered which would give permanent results with equal or even greater sensitiveness, and it seems reasonable to suppose that some of the unstable compounds used in photography might be found suitable.

Although, in the apparatus shown by fig. 2 the transmitter and receiver are connected mechanically together, they can of course be joined electrically, as in D'Arlincourt's apparatus (TELEGRAPHIC JOURNAL, January 15th, 1879).

TELEGRAPHIC APPARATUS IN USE IN THE BRITISH POSTAL TELEGRAPH DEPARTMENT.

XXVIII.

THE WHEATSTONE AUTOMATIC SYSTEM.

(*Continued.*)

FAST TRANSLATORS.

UP to distances short of two hundred miles there is but little difficulty in making the Wheatstone instrument work at its highest speed; when, however, it is required to work through longer distances, four hundred miles for instance, or through lengths of line in which a submarine cable is included, a considerable diminution in the speed is experienced. To get over this difficulty the use of "translators" or "repeaters" has been introduced, which has enabled long lengths of line to be worked to their fullest capacity.

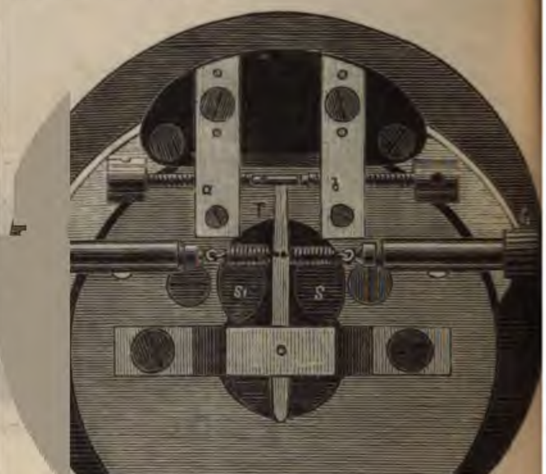


FIG. 114.

A translator is an arrangement of relays by means of which signals received are transmitted forward by means of local batteries; the whole arrangement is such that whether station A sends to B or B to A the proper signals are automatically transmitted.

The principle of the fast repeater as at present employed by the Post Office is shown by fig. 113. R_3, R_4 are two Post Office standard relays (Article V., March 15th, 1880) of the ordinary pattern. R_1, R_2 are also standard relays with additions, which are shown by fig. 114. t_1, t_2 are two thumb screws connected to two short spiral springs, s_1, s_2, by means of which the tensions of the latter can be regulated. These springs are connected to the tongue, T, and by their tensile force keep the contact piece of the latter intermediate between the contact screws, a and b. Thus when a series of reversed currents are sent through the relay the tongue, T, is attracted over against one contact stop or the other,

but when the currents cease, T remains intermediate between a and b, and touching neither.

M_1 and M_2 are "automatic switches," one of which is shown by fig. 116. This piece of apparatus consists of two electro-magnet bobbins provided with two armatures, one at each end; each armature has a contact tongue, which play between contact points. When no current passes through the electro-magnets, the tongues rest against the outer contact screws, but when attracted they make contact with the inner contact screws.

Between the ends of the electro-magnet coils a *shunt*, equal in resistance to the former, is connected. This shunt is placed in the base of the instrument, and its object is to prolong the duration of the magnetism induced in the cores by the action of the current; thus, if a current be sent through the coils and the armatures become attracted, then when the current is taken off the armatures do not immediately fly back but are held attracted for a second or two. If then a series of intermittent currents pass rapidly through the coils of the automatic switch the armatures become attracted and held steadily against the inner contact screws as long as their currents continue to pass.

Referring to figs. 113 and 115, it will be seen that the contact points of relay R_1 are both connected to one end of the coils of the switch, and the tongue of the relay is connected to one pole of a local battery, the other pôle of the latter being connected to the second end of the coils of the switch. The local battery referred to is also connected to relay R_2 and automatic switch M_2. Now if the tongue of, say relay R_1, be caused to vibrate against its contact stops, $_1$, $_2$, by a series of reversed currents passing through its coils, then the circuit of the automatic switch and local battery will be closed each time the relay tongue touches either stop; and, inasmuch as the period of no contact, whilst the tongue is passing from one contact to another, is very brief, the action of the shunt is sufficient to "bridge over" this interval and to keep the armatures firmly attracted during the whole time the tongue of the relay continues to vibrate. Directly the current ceases, however, and the relay tongue assumes its neutral position, then the local circuit becomes entirely open and the switch tongues fall back against their back contact stops.

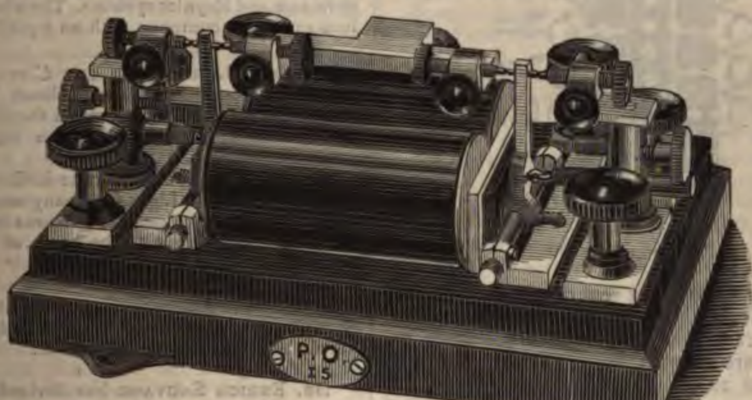


FIG. 116.

In circuit with relays, R_1 and R_2, respectively, are two standard relays of the ordinary pattern, R_3 and R_4. These relays have their contact screws connected to the poles of "split" batteries (line 1 and line 2); the split of the batteries being connected to earth. The vibrations of the tongues of these relays will cause reversed currents to be sent out through their tongues from these split batteries.

Suppose, now, a series of signals from the automatic transmitters connected to the "Up line" to be received, these signals will pass from the Up line to tongue, t_2, of the automatic switch, M_1; from thence they will pass through the right hand outer contact to the relay, R_4, and from the latter they will go through relay, R_2, and to earth. The two relays will consequently respond to the signals, and relay, R_2, will, by its action, cause the automatic switch, M_2, to "close"; that is to say, to attract its armatures and draw its tongues, t_3, t_4, against the inside contact stops. The circuit of the line 2 battery connected to relay, R_4, is now complete through the tongue of the latter and through the inside right-hand contact screw of M_2 to tongue, t_4, and from thence to "Down line." Thus, the signals received from the "Up line" are repeated to the Down line by means of the line 2 battery.

It will be noticed that a portion of the current from the line battery will split between the inside right-hand and the inside left-hand contact screws of the switch, M_2; the second portion of the current passing through tongue, t_3, and a "Receiver" (Article XXV.) and from thence through tongue, t_1, and a resistance, R, to earth. This resistance coil is of a very high value, so that it drains off but a very small portion of the current from the split battery, the major portion going out to the "Down" line.

The receiver is of the ordinary Wheatstone form, and receives a copy, as it were, of the signals sent out to the "Down" line. This enables the clerk in charge of the translator to see whether the signals are being properly transmitted. This receiver is also in circuit, through tongue, t_3, with the resistance coil, R^1, so that when signals are being sent from the Down line and repeated on the "Up" line, the state of the signals in this case also can be seen.

The action of the translator when the "Down"

line is sending signals is obviously the same as has been described, only in this case the relays R_1 and R_2, respond, and the automatic switch M closes. The actual arrangement of the repeater board according to the most recent design is shown by fig. 115.

The "Up" and "Down" lines, before passing to the tongues of the automatic switches, pass through galvanometers, thence through keys 1 and 2 respectively; the currents passing in at terminals *d*, and out at terminals *c* of the keys.

The back and front contacts of the keys 1 and 2 are connected to the poles of the split batteries, and by means of hand switches the levers of the keys can be connected direct to the "Up" and "Down" lines respectively. A sounder, S, is connected to the receiver in the ordinary way, and is

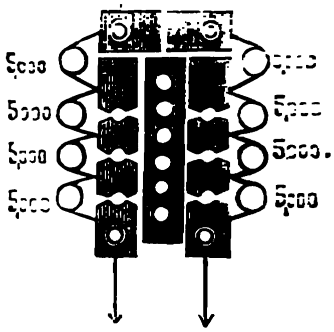


Fig. 117.

used when signals are being sent or received by the hand keys. The resistance coils used in connection with the receiver, and which are known as "leak" coils, are shown by fig. 117. By this means, 5,000 to 20,000 ohms can be inserted in each circuit.

Notes.

The Invention of the Return Wire Circuit for Telephones.—An interesting controversy as to priority of invention has been going on before the Patent Office for the past two years between Alexander Graham Bell, the telephone inventor, and David Brooks, of Philadelphia, the well-known electrician. The invention in dispute was the use of a return wire on a telephone circuit, to prevent the noises of induction. On some of the city telephone lines the noise produced by induction from electrical currents is so great as to form a serious obstacle to the use of telephone instruments. If one attempts to listen there is such a loud bubbling noise heard, and such a mixture of clicks and other voices, which come in from the neighbouring wires, that the principal satisfaction of conversing with one's correspondent is taken away. If the telephone wire passes in the vicinity of Western Union wires, on which Gray's harmonic telegraph instruments happen to be at work, then there is added to the general confusion of tongues a series of tootings or cat calls that are quite distressing to the ears of sensitive telephoners. Professor Bell and Professor Brooks discovered the remedy; it consists in using two wires on the telephone circuit instead of a single wire. If an extra wire insulated is stretched close alongside of the usual single wire the extra being employed as a return circuit wire instead of the earth, then all noise from induction disappears and telephoning becomes a pleasure.

The Commissioner of Patents decides that the priority of invention belongs to Prof. Brooks, he having made the invention in July 1877, whereas Bell did not make it until the end of August, 1877. But, more than this, Bell's date of invention must, by law, be carried forward to the date of the final enrollment of his English patent, May 18, 1878; as it is not allowable, in this country, so far as proofs of invention are concerned, for any applicant, if he takes a foreign patent before he applies for an American patent, to go back of the date of his foreign patent. Bell did not apply for his American patent until December 20, 1878. The Commissioner of Patents, therefore, reversed the decision of the Board of Examiners in Chief, and awards the discovery to Professor Brooks, to whom it clearly belongs.—*Scientific American.*

We learn from two or three sources that in France a fusion of interests has taken place, as regards the companies representing the Jamin, Jablochkoff, Werdermann and Reynier systems. The whole being formed into one large company with an equally large capital.

Electric Lighting in the City.—Owing to the bad weather, the engineer (Colonel Haywood, C.E) states that he has had to extend the time for the commencement of experiments, from March 1st to the beginning of April.

Messrs. Siemens Brothers & Co. and the Anglo-American Electric Light Company seem to be pushing ahead with their respective portions of the work, but as yet very little is to be seen of the Jablochkoff system.

The Anglo American Electric Light Company.—The shares of this company are to be henceforth quoted in the Stock Exchange official list.

Dr. Enrico Sauvage has devised a new secondary battery in which the electrodes are formed of porous fragments of retort-coke. Though inferior in power and duration to a Planté element in good condition with electrodes of lead the element in question is cheaper, can be more easily and quickly constructed, and furnishes a current of long duration.

E. Mercadier (*Il Progresso*) concludes that radiophony does not seem to be an effect produced in the mass of the receiving plate which vibrates transversely in its totality like an ordinary vibratory plate. The nature of the molecules of the recipient and the manner of their aggregation do not seem to exert a predominating influence on the nature of the sounds produced. The radiophonic sounds result principally from an action on the surface of the recipient and the sounds are relatively very intense.

The French government have under consideration the substitution of the electric for oil lighting in 42 of the lighthouses on the French coast. After a series of experiments which have proved successful, the administration of French lighthouses has given an order to M. de Meritens to build six magneto-electric machines for the three first lighthouses which are to be illuminated by electricity.

M. Leon Manet has devised a process for bleaching blood albumen by means of the electric light.

Proceedings of Societies.

PHYSICAL SOCIETY.—FEBRUARY 12th.

Prof. W. G. ADAMS in the Chair.

THIS being the annual general meeting, the yearly report was read by the chairman. The report showed that the Society now numbered 321 members as against 298 of last year. Two eminent members, Sir T. H. Elliot and the Rev. Arthur Rigg, had been lost by death. The Society had decided to republish the scientific papers of Dr. Joule in a collected form.

Dr. ATKINSON, treasurer, read the balance-sheet for the past year, which showed the Society to be flourishing. The new council and officers were then elected, Sir W. THOMSON retaining the presidency. Mr. BAKEWELL and Herr G. WIEDEMANN were created honorary members. Votes of thanks were passed to the Lords Commissioners of the Council of Education for granting the use of the meeting-room to the Society, to Prof. ADAMS, to Dr. GUTHRIE the demonstrator, the auditors, and the secretaries, Professors RHEINOLD and ROBERTS. The meeting was then resolved into a special general meeting, and a resolution put and carried giving the council power to invest money of the Society in the name of the Society or of persons appointed by them, in certain stock, home and foreign. The meeting was then constituted an ordinary one, and Mr. T. WRIGHTSON, C.E., read a paper by Prof. CHANDLER ROBERTS and himself on the density of fluid bismuth. By means of the oncosimeter, an instrument which records on a band of paper the sinking or floating effect of a ball of the solid metal immersed in the molten metal, they had determined the density of fluid bismuth from six experiments to be 10·055. A former value by a different method was 10·039. In the discussion which ensued Mr. WRIGHTSON stated that his experiments proved solid cast iron to be heavier than fluid, and to sink in the latter when first immersed; but it rapidly became lighter as its temperature rose, till it floated when in its plastic state, and was consequently lighter than when in the molten state. The oncosimeter could be utilised for determining the change of volume in melting rocks, and Prof. CHANDLER ROBERTS suggested that it might throw light on the difference of state between the carbon of gray pig and white iron.

Dr. O. I. LODGE exhibited working models showing the hydrostatic analogies between water and electricity. A battery was represented by a pump, conductors by open pipes, dielectrics by a pipe closed by an elastic membrane, electrometers by pressure gauges. With these analogues he showed the action of a Leyden jar, and the passage of telegraphic signals along a cable.

THE SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.

AN ordinary general meeting of this Society was held on Thursday, February 24th, Professor CAREY FOSTER, President, in the chair. The minutes of the last general meeting having been read and confirmed, and the list of new and proposed members read, the discussion on Mr. Alexander J. S. Adams' paper on "Earth Currents and Electric Tides" was continued.

Mr. CHR. DRESING stated that the results of some experiments he had made, and which had been described by him in the TELEGRAPHIC JOURNAL for April 1, 1878, proved that changes in the direction of the earth currents took place every six hours, and the maximum electromotive force attained was three to four Leclanché cells. It was noticed that the changes were gradual, and coincided with the tidal wave.

Mr. ELLIS, of the Greenwich Observatory, drew attention to some photographic records of the magnetic storm which occurred on the 31st of January. Earth current observations were taken on two wires, one running from the Observatory to Anglesea Wharf, and the other running to Blackheath Tunnel. The currents commenced at about three o'clock and continued till eight, and occurred again at one a.m. the next day. The magnetic observations accorded exactly with the electrical, as is always the case without exception. On January 13th, which was a quiet day, there were no magnetic disturbances, and on that day the earth current intensity showed a straight line. The results of thirty years' observations proved that the disturbances were coincident in time with the appearance of the sun spots. It was noticed that the electrical condition of the earth's surface was not affected by the magnetic storm. The magnetic observations were threefold—viz., for declination, for horizontal, and for vertical force. These were affected in different ways—the declination varied 1 to 8, equivalent to 9″ of arc. The age of the moon did not vary the changes.

Mr. C. F. VARLEY said that it would be interesting if exact figures could be given of Mr. Adams' observations, so that they could be compared with the Astronomer Royal's results. In 1859 he pointed out that it would not do to take the results obtained with land lines as proving anything definite, as in certain cases he found that the currents on two lines running north and south gave currents in one direction, whilst a wire between the two also running north and south showed a current in the reverse direction. This was due to the neutral potential line running in a circle. These lines were nearly perpendicular to the coast, owing to the sea conducting better than the earth. The only trustworthy way to obtain correct results would be on cables between islands. It has been noticed that the sun caused neap and spring tides, and very probably it also caused a similar electric tide. With reference to the cause of the currents, he considered it probable that the action of the sun on the atmosphere caused a change in the distribution of the electric potential, and therefore a current to be produced.

Mr. S. M. BANKER was of opinion that the electric tides were purely due to solar influence, as the periodic changes closely coincided with the solar changes, and it was difficult to explain why there should be a lagging behind in the change of the currents with the changes of the moon if the effect was due to lunar influence. The action of the sun on oxygen was powerful, and this gas being in the air, and a magnetic body, the changes in its distribution could produce the effects noticed. It has been observed by him that on the London-Cork circuit the instruments worked well from 10 to 11.30 a.m., and that there was then a difficulty up to 2 p.m., when good working could be resumed.

Mr. WILLOUGHBY SMITH stated that he had made experiments with two cables laid across the Thames, the further ends being sealed up and the nearer ends put to earth through galvanometers; no currents could be perceived. The results of observations he had made on several cables tended rather to confuse than to throw light upon the subject. He stated, as a curious fact, that on a good Atlantic cable, he had received a current at one end equal to 100 volts electromotive force, when there was no trace of current at the other end; on this occasion the sea was rough at one end and smooth at the other.

MR. WOLLASTON pointed out that Mr. Smith's observations with the Thames cables were useless, as the latter, being sealed at the ends, there was no circuit, and therefore no currents could possibly be produced. In reply to Mr. Graves, who stated that the London-Cardiff wire, on which Mr. Adams' observations were made had no submarine cable in its length, Mr. Wollaston said that the earth current effect, which he attributed to the tide in the river Severn, would equally affect wires spanning over the river.

MR. C. E. SPAGNOLETTI gave the results of some observations on currents made during the storm of the 31st January which tended to confirm Mr. Varley's statement with reference to the neutral line running in a circle.

In answer to SIR CHARLES BRIGHT, PROFESSOR AYRTON explained that the action of a running river would be to induce currents in itself, part of which would complete their circuit through any wire which was in the neighbourhood, and this current would be continuous.

MR. G. K. WINTER said that, the results of observations made by him showed that there was a diurnal variation in the earth currents. He attributed the magnetometer effects to currents flowing through the earth, since a small magnetic needle was more powerfully affected than a large one, which would not be the case if the deviations were due to magnetic effect alone.

After some further observations from PROFESSOR AYRTON the meeting adjourned.

Correspondence.

SEYMOUR'S BALANCE GALVANOMETER.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—In your number of January 15th occurs an article on Seymour's Balance Galvanometer, in which we find the statement that "In the medical world we seldom see accounts of carefully-conducted electrical experiments with numerical values attached." To meet this want it is stated that Mr. Seymour's instrument has been devised. Allow us to state, in the first place, that we have now for more than a year been jointly charged with the management and administering of this powerful physiological agent at the hospital named below, and that we have from the first employed careful measurement in recognised electrical standards, by means of a modified Thomson's galvanometer and resistance coils specially adapted to the purpose. The instrument has been fully described by one of us in the "Hospital Reports," vol. x. As regards Mr. Seymour's proposed instrument, we are unable to understand why a deflection of a galvanometer "fails fully to meet the requirements of the electrician who desires to record as accurately as possible the account of his observations." Mr. Seymour proceeds to describe a galvanometer of his own devising which seems to possess no special advantages, whilst it has several inherent disadvantages, and which is neither so delicate in its action nor so simple in manipulation as the instrument above-named already placed before the public.

One very great objection to Mr. Seymour's instrument is that a new and perfectly arbitrary unit is introduced which has no physiological value, and which differs from those used by observers generally. This unit is a grain. Unless Mr. Seymour has omitted a very important part of his description the value of a grain varies with every instrument, and cannot under any circumstances be compared with the well-understood foot-grain-second unit. With the latter unit a current of 1 weber has a value of about ·07 grains, whilst with the instrument described it would be about 238 grains, and with a second instrument quite a different number. Consequently this galvanometer, instead of simplifying calculations, absolutely increases them.

The weights he uses are riders placed upon the beam of the instrument. They must necessarily be small and troublesome to adjust whilst administering the current to a patient, thus greatly deducting from the practical utility of the instrument.

Rapidity of action is frequently absolutely necessary for accuracy in testing the electric condition of the muscles, &c. The wording of the description implies that although possible it is difficult to weigh $\frac{1}{100}$ grain. Now this, with the instrument in question, has a value of 42 microwebers. It may be as well, by the way, to notice that Mr. Seymour has conducted all his experiments with Leclanché cells, whose E.M.F. he takes as 1·5, whereas they really have a very variable E.M.F., higher or lower according to the quality of the manganese used in their construction.

The formidable list of uses to which he applies his galvanometer only contains those in which galvanometers are ordinarily employed for the therapeutical administration of the galvanic current. He omits, perhaps from want of delicacy in his instrument and difficulty of manipulation, the important use of a galvanometer for diagnostic purposes, where accuracy and rapidity of action are positively essential.

Your obedient servants,
WILLIAM H. STONE, M.A., M.B., Oxon.
WALTER KILNA, M.A., M.B., Cantab.
Physician and Electrician to St. Thomas's Hospital

14, Dean's Yard, Westminster, S.W.
February 18th.

City Notes.

Old Broad Street, February 25, 1881.

SUBMARINE TELEGRAPH COMPANY.—The report of the directors submitted to the meeting held at the City Terminus Hotel on the 23rd inst. states that the gross receipts for the six months ending 31st December, 1880, amounted to £67,237 14s. 10½d., as shown in the annexed accounts; and on comparing this sum with the receipts for the six months ending 31st December, 1879, there will be found an increase of £5,924 17s. 8½d. This increase arises partly from the amount payable to the Company by the Paris and New York Telegraph Company, under the agreement referred to in the last report of the directors, but chiefly from the ordinary sources of traffic. In the half-year ending 31st December, 1879, the word rate was restricted to Germany and Holland, and 939,892 messages were transmitted, while in the corresponding period of the year 1880 the new tariff was applied to the correspondence of the whole of Europe, and the number of messages transmitted amounted to 1,370,977, showing an increase of 431,085 messages, and producing an additional revenue of £3,800 17s. 10½d. The directors have added 10 per cent. of the gross receipts, £5,592 19s. 5d., to the reserve fund, in lieu of 5 per cent., in accordance with the resolution passed at the last meeting of the proprietors; and the net result of the half-year's business enables the directors to recommend a dividend at the

rate of 19 per cent. per annum, and carry over a balance of £968 0s. 4d. The directors have taken possession of the Company's new offices in Throgmorton Avenue, and all the wires were successfully transferred from Threadneedle Street on the 15th January last, without the least interruption to the service. At the meeting the chairman, in moving the adoption of the report, said at the last meeting he had to state that there was a considerable increase of messages but a diminution in the receipts. He was happy to be able to state on the present occasion that there had been a considerable increase both in messages and receipts, which only proved that the word traffic had resulted in all they expected from it. It must be remembered that cables were cables, and liable to considerable wear and tear, and although they had not the liabilities attached to the deep sea cable system, yet in time their own must require renewal. A good reserve fund under such circumstances would become a matter of necessity, and he therefore hoped that they would not continue the 10 per cent. He was glad to be able to inform the shareholders that they had taken possession of their new premises. The transfer of the wires and the entire change had been carried out without the slightest disturbance of the system either in London or Paris. The directors felt that the time had arrived when it would be advisable to consider the propriety of instituting some sort of fund, which, in the case of sickness, old age, or death, would become a benefit to the staff who had served them so well. Mr. Ford (a shareholder) seconded the motion, which was carried, as was a resolution in favour of a fund, it being left to the directors to submit a scheme at a future meeting. A vote of thanks to the chairman, directors, and staff terminated the proceedings.

THE DIRECT UNITED STATES CABLE COMPANY, LIMITED.—The report of the directors for the six months ending 31st December, 1880, presented at the seventh ordinary general meeting held at the Cannon Street Hotel to-day, states that the revenue for the half-year, after deducting out-payments, amounted to £59,815 6s. 5d., as compared with £120,445 8s. 6d. (after similar deductions) for the corresponding period of 1879, being a difference of £60,630 2s. 1d. against the half-year under review; this difference being entirely due to the operation of the competitive tariffs in force during a portion of this period. The working and other expenses for the same period, including interest on debentures, and income tax, &c., amounted to £26,233 8s. 11d., leaving a balance of £33,581 17s. 6d. as the net profit for the half-year, making, with £21,760 8s. 10d. brought forward from the previous half-year, a total of £55,342 6s. 4d. For the corresponding half-year of 1879, the working expenses and other payments amounted to £25,001 3s. 6d. Interim dividends of 1½ per cent. each for the quarters ending 30th September and 31st December, 1880, together amounting to £30,355, have been declared and paid. The sum of £21,870 8s. 9d. has been set aside to reserve fund (thereby increasing that fund to £200,000), and the balance of £3,116 17s. 7d. is carried forward. The £100,000 debenture loan has been received in full. An interruption occurred in the short section of the cable on Brown's Bank on the 23rd December, 1880, and was repaired on the 4th January, 1881. Another interruption occurred in the same section and in the same locality on the 18th January, 1881, and was repaired on the 27th January, 1881. These prompt repairs were effected by the s.s. *Minia*, under the command of Captain Trott, who reports that the breakage in each case had been caused by ship's anchors. The provisional agreements recently entered into between the Anglo-American Telegraph Company, the Direct United States Cable Company, and the Compagnie Française du Télégraphe de Paris à New York, having for their object a division in agreed proportions of the traffic receipts of the three Companies, were approved at extraordinary general meetings of the proprietors of the three Companies, held in Paris and London on the 12th and 14th ultimo respectively.

TELEGRAPH CONSTRUCTION AND MAINTENANCE COMPANY, LIMITED.—From the report of the directors to be submitted to the shareholders at the meeting to be held on the 1st of March, it appears that the accounts for the year show a net profit of £98,673 10s. 10d. after charging the interest on the debentures. To this sum must be added £68,701 9s. 3d. brought forward from last year, making a total of £167,375 0s. 1d. From this amount is deducted the interim dividend of 5 per cent., paid July 20th, 1880, amounting to £22,410, leaving £144,965 0s. 1d. to be dealt with. Of this sum the directors propose to distribute a dividend of 15 per cent. or £67,230, being at the rate of £1 16s. per share, and making, with the amount already paid, a total dividend for the year of £2 8s. per share in cash, free of income tax, leaving £77,735 0s. 1d. to be carried forward to the next account. The operations carried out during the year 1880 have been as follows:—The Eastern Extension Telegraph Company's duplicate Australian Cable, alluded to in the last annual report, was finally completed in the month of January. A cable, 108 miles in length, connecting the Northern and Middle Islands of New Zealand, was laid for the New Zealand Government in the month of February. A cable between the Island of Luzon (Manilla), and Hong Kong, 299 miles in length (for which a concession was obtained from the Spanish Government in February, 1879), was completed in the month of April last, and has since been transferred to the Eastern Extension Telegraph Company. The deep sea portion of the Anglo-American Telegraph Company's Atlantic cable of 1866 has been renewed. This work was successfully carried out with the steam ships *Scotia* and *Seine* during the month of August. Subsequently a multiple cable, 209 miles in length, was laid for the same company between Newfoundland, St. Pierre, and Sydney, Cape Breton. In the month of September a cable was laid for the Great Northern Telegraph Company of Copenhagen, connecting Newbiggin, on the east coast of England, with Arendal, in Norway; and Arendal, with Marstand, on the coast of Sweden—the total length being 518 miles. Other lengths of cable have been made for various companies, bringing the total amount manufactured during the year to 3,453 miles. The erection of permanent stations for the Eastern and South African Telegraph Company's line, and the connection of the underground land lines with them, in accordance with the terms of the contract, are still in progress.

THE MEDITERRANEAN EXTENSION TELEGRAPH COMPANY, LIMITED. — The forty-seventh ordinary general meeting of the shareholders of the Mediterranean Extension Telegraph Company, Limited, was held yesterday, at the City Terminus Hotel, Cannon-street, E.C., Sir James Carmichael, Bart., the chairman of the Company, presiding. The report and accounts for the half-year ending December 31st last, showed a decrease in the traffic to the amount of £250, attributable in some degree to the operation of the word tariff, which had scarcely answered the expectations of the change from the previous rates. The amount to be claimed under the guarantee would, therefore, be proportionately heavier than

for the previous half-year. The Company's cables were in good order, and the cost of repairs and maintenance had been light. The directors proposed payment of the usual dividend, at the rate of 8 per cent. per annum, less income tax, on the preference stock of the Company, and of 3 per cent. per annum, free of income tax, on its ordinary stock, payable on and after the 7th proximo, leaving £462 to be carried to the reserve fund. The chairman said he thought he need hardly detain them with any remarks from himself. As they would have seen by the report, there was a slight falling off in the receipts, attributable to the operation of the word system, although there had been an increase in the number of messages, and since the date of the report there had been an increase in the receipts. They hoped next half-year to be able to report more favourably, and not to have to draw to such a large extent on the treasury. He concluded by moving the adoption of the report and accounts. The Hon. Ashley Ponsonby, a director, seconded the motion, which was carried, and the proposed dividend declared. The chairman, in reply to a shareholder, said the Government guarantee had to run two years longer. The usual vote of thanks was accorded to the chairman and directors.

THE INDIA-RUBBER, GUTTA-PERCHA, AND TELEGRAPH WORKS COMPANY last month despatched an expedition to lay submarine cables for the Mexican Telegraph Company between Brownsville in Texas and Vera Cruz in Mexico, with a station at Tampico, and news has been received by telegraph of the completion of the section from Brownsville to Tampico. These cables will place the telegraph system of Mexico in communication with those of the United States and Europe, and the Mexican Telegraph Company intend to carry a land line across the isthmus to Tehuantepec, and lay cables thence to Panama, under contracts already obtained with the Republics of Guatemala, Costa Rica, Nicaragua, and Columbia.

THE MONTREAL TELEGRAPH COMPANY.—The annual report of this Company gives a comparative statement of the gross revenue and expenditure for the last six years, which is as follows:—

	Revenue.	Expenditure.	Profit.
1875 ...	$550,493 34	$373,403 90	$177,089 44
1876 ...	508,919 25	357,356 24	151,563 01
1877 ...	514,122 26	345,450 83	168,671 43
1878 ...	485,302 46	343,204 84	142,097 95
1879 ...	478,435 32	335,573 86	142,861 46
1880 ...	550,840 01	358,676 08	192,163 93

From this it will be seen that the number of messages sent over the wires in 1880 was 388,071 in excess of 1879. This, of course, entailed a greater amount of expenditure, particularly in the matter of salaries, but this could not be avoided, and it is satisfactory to know that the large business of the Company has been done with great promptitude and correctness. The dividend paid in July last was 3 per cent., and that now payable 4 per cent.

INFORMATION has been received by the Cuba Submarine Telegraph Company of the successful laying of their new cable between Cienfuegos and Santiago de Cuba. This is the third cable which has been laid by the Company between these points, but as the 1870 one has ceased to work only two are now in operation.

THE EASTERN TELEGRAPH COMPANY advertise the repair of their Falmouth-Vigo cable, thus restoring telegraphic communication with Spain, Portugal, Gibraltar, Malta, and South America.

THE WESTERN AND BRAZILIAN TELEGRAPH COMPANY notify the repair of their Rio Grande do Sul, Monte Video, section, and that direct cable communication is now re-established between Europe, the Argentine Republic, and the West Coast of South America. This Company also announce that Sir Henry Drummond-Wolff, K.C.B., G.C.M.G., M.P., has accepted the chairmanship of the Company.

The following are the final quotations of telegraphs:—Anglo-American, Limited, 58¼-58¾; Ditto, Preferred, 86¾-87¼; Ditto, Deferred, 30¾-3¼; Black Sea, Limited, —; Brazilian Submarine, Limited, 9⅞-10⅛; Cuba, Limited, 8¾-9¼; Cuba, Limited, 10 per cent. Preference, 16¼-16¾; Direct Spanish, Limited, 3¼-3¾; Direct Spanish, 10 per cent. Preference, 12¾-13¼; Direct United States Cable, Limited, 1877, 10⅞-11⅛; Scrip of Debentures, 101-103; Eastern, Limited, 9⅝-9⅞; Eastern 6 per cent. Preference, 12¼-12⅝; Eastern, 6 per cent. Debentures, repayable October, 1883, 102-106; Eastern 5 per cent. Debentures, repayable August, 1887, 101-103; Eastern, 5 per cent., repayable Aug., 1899, 101-104; Eastern Extension, Australasian and China, Limited, 9⅞-10⅛; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 107-110; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 104-106; Ditto, registered, repayable 1900, 104-106; Ditto, 5 per cent. Debenture, 1890, 102-104; Eastern and South African, Limited, 5 per cent. Mortgage Debentures, redeemable 1900, 101-103; Ditto, ditto, to bearer, 102-104; German Union Telegraph and Trust, 9¾-10¼; Globe Telegraph and Trust, Limited, 6¼-6½; Globe, 6 per cent. Preference, 12-12¼; Great Northern, 10⅞-11⅛; 5 per cent. Debentures, 102-105; Indo-European, Limited, 26½-27⅛; London Platino-Brazilian, Limited, 5½-5¾; Mediterranean Extension, Limited, 2½-3; Mediterranean Extension, 8 per cent. Preference, 10¼-10¾; Reuter's Limited, 10¾-11¼; Submarine, 270-290; Submarine Scrip, 2½-2¾; Submarine Cables Trust, 99-102; United Telephone Company, 3 pm.; West Coast of America, Limited, 4¼-4¾; West India and Panama, Limited, 1½-1¾; Ditto, 6 per cent. First Preference, 6-6½; Ditto, ditto, Second Preference, 5¼-5¾; Western and Brazilian, Limited, 7⅜-7⅝; Ditto, 6 per cent. Debentures "A," 103-107; Ditto, ditto, ditto, "B," 98-102; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 122-127; Ditto, 6 per cent. Sterling Bonds, 104-107; Telegraph Construction and Maintenance, Limited, 36-36½; Ditto, 6 per cent. Bonds, 105-108; Ditto, Second Bonus Trust Certificates. 3⅛-3⅜; India Rubber Company, 18½-19; Ditto, 6 per cent. Debenture, 107-109.

TRAFFIC RECEIPTS.

NAME OF COMPANY.	JANUARY.		INCREASE OR DECREASE.
	1881.	1880.	
	£	£	£
Anglo-American.........	*	...	...
Brazilian Submarine...	12,629	...	...
Cuba Submarine	2,800	3,406	Dec. 606
Direct Spanish	1,506	...	...
Direct United States...	*	...	...
Eastern	49,445	48,887	Inc. 558
Eastern Extension	29,491	28,009	Inc. 1,482
Great Northern	17,360	17,297	Inc. 63
Indo-European	...	...	...
Submarine	*	...	...
West Coast America ...	...	...	...
Western and Brazilian	8,567	9,153	Dec. 586
West India	...	...	...

* Publication suspended.

THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. IX.—No. 195.

NEW TELEPHONES.

IT is somewhat remarkable that in spite of the enormous number of experiments which have been carried out, surprisingly little progress has been made towards obtaining a perfect telephone. Progress *has* been made, undoubtedly, but it is out of all proportion to the amount of energy which has been expended on the subject. Theoretically, a telephone to speak out as loud as desired is as apparently possible as the possibility of making an extremely weak telegraphic current, relay an equally strong current with certainty. The weak received telephonic currents should apparently be able to unlock corresponding currents of a much greater intensity, or the action of the transmitter should be able to control currents sufficiently powerful to produce a giant's voice, yet actually nothing like this result has been accomplished. The so-called loud-speaking telephones indeed approach the threshold of the theoretical possibility, but they seem unable to go further.

Loud speaking, it is true, is not required, or indeed desirable for general use, but clearness of utterance is, and if the general problem be solved, it is always possible to tone down and shape to any particular requirement, just as a Koh-i-noor can be shaped down from a large shapeless mass, though we cannot produce it from a less bulk.

We continually hear of new forms of telephones which are stated to give wonderful results, but we must confess that our experience of such inventions has been anything but hopeful, as they almost invariably fail to give the glowing results which their inventors claim for them, except under extraordinary conditions.

It is rarely that we hear of distinct departures from the old lines in inventions: inventors are disinclined to attempt to obtain effects from unpromising materials, and a few unsuccessful trials usually drives them back into the old groove, so that they content themselves with improving what they know will work rather than go groping in the dark after what may after all prove to be an idle dream.

Although Dr. Herz's telephone, which was described in our last issue, was foreshadowed to some extent, yet the results obtained are somewhat surprising, and are likely to prove of considerable value, inasmuch as they prove the practicability of obtaining telephonic communication by other means than those which are at present considered to be the exclusive property of one or two individuals. The statement that an efficient microphonic transmitter can be formed from other materials than carbon is important if the employment of the latter material is covered by a patent, which point we understand is to be contested. The use of a receiver which is not magnetic is also an important feature, as we believe such a receiver is not the subject of an existing patent, at least in this country. If, therefore, Dr. Herz's discoveries promise as well as they appear to do, they may inaugurate a new era in telephony.

It is claimed by the inventor that his system avoids that bugbear of telephony, viz., "induction;" this we are inclined to think is only partially the case, and the theory that it should effect the cure because there is no circuit, is entirely fallacious and contrary to theory.

The effect of one current flowing in the neighbourhood of another is to disturb the equilibrium at the moment when the current flows or ceases to flow. If the wire in which the equilibrium has a tendency to be upset, be disconnected at both ends, then the conditions for a variation cease to exist; but insert a condenser at one or both ends, and then a disturbance outside the wire will tend to cause a current to flow in the wire, which current will flow into the condenser until the potential in the latter reaches a certain point dependent upon the strength of the inducing current and the capacity of the condenser; increase the latter to infinity and we shall then obtain an induced current as strong as we should get if the wire were earthed at both ends, although in the one case there is disconnection or no circuit and in the other a complete loop. *Steady* earth currents, it is true, are cut off, but if there is a variation in these they will, in virtue of their change, produce an induced effect, exactly as will the telephonic currents.

ON A SIMPLE FORM OF SELENIUM CELL AND EXPERIMENTS THEREWITH.*

By PROFESSOR JAMES BLYTH.

THE recent remarkable discovery of the photophone by Professor Graham Bell has turned the attention of experimenters to a peculiar property of selenium first discovered by Mr. Willoughby Smith. That

* Read before the Royal Society of Edinburgh.

property is that, in the crystalline state, its electrical resistance varies under the influence of light.

Since the specific resistance of selenium is very high, it is obviously necessary, in order to make a selenium cell as sensitive as possible, to obtain a long, thin layer of it between two parallel conductors which serve as electrodes, and so to arrange this layer that as great a length of it as possible can be brought under the influence of light at one time. It struck me that a good way of fulfilling these conditions would be by making the cell in the form of two interlacing combs, and by placing the selenium between the teeth. For this purpose I obtained two similar brass pocket combs, and having knocked out each alternate tooth from both, I screwed them down to a piece of dry wood with the teeth interlacing, but taking care not to let them touch in any part. Copper wires soldered to the back of each comb formed the electrodes.

Having heated up the combs in front of a bright red fire to the melting-point of selenium, the selenium was carefully rubbed in between the teeth, and the cell annealed in an air bath whose temperature could be watched by a thermometer. During the whole annealing process the cell was joined up in the ordinary way with a resistance-box and Wheatstone bridge, and the variation of its resistance carefully watched. The resistance was found to decrease as the temperature rose, till it reached a minimum, and then began to increase again. At that point the heat was withdrawn, and the cell allowed gradually to cool. The selenium then presented a crystalline appearance.

My first supply of selenium falling short, I ordered a second, and made a cell with it precisely similar to the former. This cell, however, presented some perplexing peculiarities, inasmuch as although its resistance came down very low, to something like 170 ohms, I found it almost entirely insensitive to the influence of light. This is, I have no doubt, due to some impurity in the selenium, which I hope to detect by a chemical analysis which is now being made for me.

I have also made the comb cell in a cylindrical form by bending the comb round a glass tube and soldering the edges together. When this form of cell was placed round a tube containing a singing flame, and joined up in circuit with a telephone and a battery of twenty Grove's cells, I was able to hear the singing of the flame distinctly reproduced in the telephone.

Having obtained a cell which was sensitive to a singing flame, it was an easy step to find if it would be equally sensitive to the variations produced in the flame of a Koenig's capsule by speaking against the membrane. This I found to be the case, the articulation being produced very clearly. This result is of great interest, as it shows the remarkable rapidity with which the resistance of the selenium must vary before it can reproduce articulation by the mere variation of the light from a small gas jet. The same result has also been recently shown by Mr. Jamieson by means of his highly sensitive and ingenious form of cell.

I have also arranged the comb cell in what may be called the radial form. This form is made by fixing a circular disc of brass to the end of a cylindrical piece of dry mahogany. Twenty-four saw cuts are then made right down through the centre of the disc and equally inclined to each other. The brass disc is thus cut up into twenty-four equal-sized sectors, and the selenium is placed in the narrow slits between them. The first, third, fifth, &c., sectors are connected by a wire which serves as one electrode, and the second, fourth, sixth, &c., by another wire serving for the other electrode.

Being in great measure brought to a standstill in my experiments from the want of good selenium, I began to think if something could not be got which would serve as a substitute; and the first thing I determined to try was amorphous phosphorus. For this purpose I packed the slits of a radial cell with the phosphorus, and proceeded to test its resistance by the bridge in the ordinary way. I was surprised to find, however, that I could not obtain a balance. This at once led me to suspect that the cell itself was acting as a voltaic battery; and on joining it up directly with the galvanometer, I at once saw that this was the case from the strong deflection of the spot of light. I also found that the deflection varied by pressing the phosphorus, and this led me to suppose that amorphous phosphorus might be made to play the part both of battery and loose contact as a transmitter in a telephone circuit.

I immediately made such a transmitter, which consisted simply of a shallow box with a brass disc at the bottom, to which one electrode was attached, and a lid made of very thin sheet brass, to which the other electrode was attached. The phosphorus was placed between the two brass pieces, and a mouthpiece was arranged, by means of which the voice could be directed against the thin brass lid. With this transmitter in circuit with a telephone, and without any battery but itself, I could hear articulation perfectly transmitted. With two bichromate cells in the circuit the articulation was surprisingly loud and clear.

THE HISTORY OF SELENIUM AND ITS ACTION IN PROFESSOR GRAHAM BELL'S PHOTOPHONE, WITH DESCRIPTION OF NEW FORM.*

By A. JAMIESON, C.E.

THE discovery of the non-metallic element selenium (symbol, Se; atomic weight, 79·0; vapour density, 79·0; specific gravity, 4·5, varies according to condition) is due to Berzelius, who observed it in the deposit of sulphuric acid chambers at Gripsholm, in Sweden, in the year 1817, when attempting to obtain a new source of supply of the rare metalloid, Tellurium. The name is derived from Σελήνη, the moon, on account of its analogy with the element, Tellurium (*tellus*, the earth), which had been discovered previously and so named by Klapworth in 1798.

Selenium is widely distributed, but only obtainable in small quantities from iron and copper pyrites, the smoke from the furnaces of silver works, the deposit in leaden chambers at sulphuric acid works;

*Extracts from paper read before the Glasgow Philosophical Society.

and it has also been found in metallic copper of commerce.

The present price of selenium ranges from 10s. to £1 10s. per ounce, and the author has been greatly indebted to his friend, Mr. Robert Tattock of this society, for procuring the specimen exhibited, as well as the other pieces with which he has experimented in making sensitive selenium cells.

Selenium appears in two chemical allotropic modifications; the one soluble, and the other insoluble, in disulphide of carbon ($C\ S_2$). That soluble in disulphide of carbon has been called "red selenium," "amorphous selenium," and "glassy selenium." It is a bad conductor of heat and a non-conductor of electricity. That *insoluble* in disulphide of carbon (and which is the element of interest at present) has been called "black selenium," "granular selenium," "metallic selenium," and "crystalline selenium."

Mr. Willoughby Smith, Electrician in Chief to the Telegraph Construction and Maintenance Company, was the first to bring prominently before the scientific world the curious electrical properties of selenium. He was the inaugurator of an important system of electrical testing and signalling in connection with the laying of long telegraph cables, in which it was necessary to employ high resistances of many megohms; and as a single megohm coil well made of platinum silver wire costs about £80, his attention was drawn to the high resistance which selenium offered to the passage of electric currents, and he found that he could produce equally reliable results with this material, at a price of 30s.

Selenium was thus first introduced as of practical use in the important process of the laying of submarine cables in 1873-74 (and not 1866 as has been reported), and has been found so well adapted to the purposes required, that the Telegraph Construction and Maintenance Company never fit out an expedition of importance without including resistance boxes of this curious and subtle material.

Mr. Willoughby Smith soon recognised (with the assistance of Mr. May) the peculiar effect which light and heat had upon the electrical conductivity of selenium; and he brought before the Society of Telegraph Engineers several important communications (February 4th, 1873; March 8th, 1876; November 28th, 1877), wherein he described a number of experiments which he had carried out relating to the matter.*

Dr. Werner Siemens of Berlin, Dr. C. W. Siemens of London, Professor W. G. Adams of London, Lieut. Sale, R.E., the Earl of Rosse, and other electricians, took up the matter at this point, and proved several curious facts.

It remained, however, for Professor Graham Bell and Mr. Sumner Tainter to discover last summer the possibility of the transmission of musical notes and speech by means of an undulatory beam of light projected from a disc (vibrating under the action of the voice) upon a sensitive selenium cell, the latter being in circuit with an electric battery and telephone. Following up Professor Bell's discovery, the author found out that musical sounds and speech can be transmitted by a *gas flame (governed by the voice) acting on selenium.*

Previous to Professor Bell's experiments, the following had been elicited regarding the action of light and heat upon "granular selenium," viz., that it exhibits three different electrical properties, according to the temperature and mode of treatment by which it is prepared.

I. If prepared at a temperature of *not* above 100° C. it is a very bad conductor of electricity, and does not acquire conducting properties on exposure to light or a short exposure to moderate heat rays.

II. If melted quickly and raised to 210° C. and cooled quickly, it conducts much better than No. 1, is poorly sensitive to light, and its conductivity increases rapidly upon raising its temperature. It however still retains metallic appearance of No. 1, but to a lesser degree.

III. If melted and pressed between the wires of a gridiron of fine brass or copper wires, then cooled, and afterwards carefully annealed, by being raised to various temperatures, between 120° C. and 210° C., and kept at the latter temperature for some time, and then very gradually cooled, the glossy metallic appearance becomes changed to a dull slate or lead colour; the conductivity is generally very good, say from 300 to 3,000 ohms at 100° C. in the dark. Selenium thus prepared is very sensitive to light, and fairly so to an equivalent amount of heat rays. Plan No. III. is the best for securing a sensitive cell; but as selenium varies so much in quality, *no hard and fast rule can be laid down for manipulating it.*

Some experimenters affirm that the conductivity of selenium decreases with rising temperature, and, therefore, that it behaves like a metal; but the author has in every case found with his cells that an increase of temperature was accompanied by an increase of conductivity, so long as the temperature did not exceed 213° C. (see Table I.), or, in other words, that selenium invariably behaves like a dielectric at temperatures below 213° C.

The conducting power of a selenium cell is effected by time on exposure to light; that is to say, a momentary exposure will reduce the resistance, and a continued exposure will still further do so; but it takes a much longer time to regain its normal resistance on being confined to darkness. For example, if exposed for a couple of seconds to the light from an ordinary gas jet, at two inches distance, it will take several minutes, at least, to completely regain its original resistance on return to darkness. Daylight and direct sun-rays have a much greater effect in reducing the resistance than gas or lamp light. Earl Rosse and Dr. Werner Siemens showed that the variation in resistance of selenium is proportional to the square root of the intensity of illumination. The author has found that a selenium cell increases in resistance with age, as may be seen by reference to tests of cell No. 3 (Table II.), which is contrary to Professor W. G. Adams' report (Vol. vi. p. 442, "Soc. Tel. Engs. Journal.")

Granular, or insoluble selenium, has no definite melting-point, as it softens gradually like sealing wax upon the application of heat, whereas the red, or amorphous, form has a constant melting-point at 217° C., and both forms pass off in a dark reddish

* It was at Aden in January, 1880, on completion of the laying of the Eastern and South African Cable by the Telegraph Construction and Maintenance Company, that the author first thought of a plan for automatic translation on long submarine telegraph cables by using selenium cells. He there saw Mr. Willoughby Smith's high selenium resistances, read his and other papers on the subject, and afterwards at Malta drew out several schemes for carrying it into operation. He, however, failed to carry it into execution, but is again trying it, believing it to be practicable and worth accomplishing.

brown vapour, at somewhere below 700° C. This vapour can be condensed, either in the form of scarlet flowers of selenium or dark shining drops. Care must therefore be taken in dealing with this expensive material not to heat it too highly (say above 300° C.). The author mentions this fact, because he unwittingly allowed a piece under treatment to disappear into vapour, while attempting to melt and smooth it down upon a cell with a red hot iron. He found, as far as the requirements for melting selenium are concerned, in the making of "sensitive cells," that the temperature need never exceed 215° C., and that the change from the glassy, metallic, high resistance condition, to that of the crystalline, or low resistance state, may even take place at as low a temperature as 120° C., and sometimes lower.

Mr. Willoughby Smith and others infer from their experiments that the effect of light upon selenium is, so far, independent of its accompanying heat rays, while some say that the heat rays are at the bottom of the whole matter. Upon this point there is considerable divergence of opinion.

TABLE I.

Table showing times, temperatures, and corresponding resistances, with remarks, when annealing circular form of cell No. 1 in hot air bath, joined up in Wheatstone bridge without telephone in circuit.

January 14th. 1881.

Time in Air Bath.	Temp. C.	Res. in ohms.	Remarks.
12.45 p.m. H. M.	10°rising		6 Leclanché cells used, cell put in cold at 10° C. after scraping off surplus selenium.
0 5	130°	4000	
0 10	140°	2300	Res. falling with increasing temperature, cell in perfect darkness whole time, behaving like a dielectric.
0 35	160°	1700	
0 45	185°	800	
0 48	195°	650	
0 50	200°	440	
0 55	210°	300	
0 56	210°	290	
	213°	change	At 213° C. the res. changed from decreasing, and rapidly rose with a few degrees of increasing tem., behaving like a metal
0 58	215°	350	
1.45 p.m. 1 0	218°	600	
—	—	—	
1 35	140°	295	Lowered tem., and cell fell again in res. Left cell to cool very gradually, taking various readings, res. rising again.
2 45	125°	350	
2 55	110°	360	
3 15	100°	360	
3 18	90°	340?	Cell removed, and allowed to cool, afterwards tried with singing flame and distinctly heard the note in telephone.

TABLE II.

History of No. 3 Flat Cell. Made up December 27th (3 p.m.), 1880. Showing increasing resistance with age.

Date.	Temp. C.	Resistance in ohms.		
		In dark.	In light, about 2 in. from gas.	Differ. in ohms. between dark and light.
1880, Dec. 27	About 100° C.	530	—	—
28	—	2700	1690	1010
29	About 25° C.	3180	1620	1560
,,	After several exposures to light.	2250	1120	1130
—	—	—	—	—
1881, Jan. 10	—	3300	2350	950
14	Nearly freezing.	6700	2900	3800
15	About 5° C.	6900	3200	3700
19	After handling and exposure.	6200	3900	2300
,,	At lecture, warm room, about 20° C.	5740	2340	3400

The above cell answers admirably, and truthfully reproduces singing and speech.

Tests, since lecture, of the above cell :—

Date.	Temp. C.	Resistance in ohms.		
		In dark.	In light, about 2 in. from gas.	Differ. in ohms. between dark and light.
1881.				
Jan. 22	After long confinement to darkness, 10° C.	(Z. & C.) 8500	3440	5060
24	9·0°	,, 8500	3040	5460
25	9·5°	,, 8500	3100	5400
26	6·0°	,, 9900	3940	5960
28	9·3°	,, 8300	4940†	3360
31	10·0°	,, 9740	4270	5470
Feb. 3	12·0°	,, 9540	3500	6040
16	11·0°	,, 10000	4700	5300
17	11·0° *	,, 9730	4370	5360
21	10·0°	,, 11100	5170	5930

Mr. Jamieson is still testing this cell, and although the resistance is gradually rising with age, yet he cannot perceive as yet any diminution in its power of reproducing singing and speech, in fact, it seems to have more resilience than when at a lower resistance, just like a keen stiff spring in comparison with a wabbling soft one; and he does not think Professor Sylvanus Thompson will find much benefit in trying to reduce the resistance of Mr. Shelford Bidwell's cells very much by increasing their area beyond certain limits.

While trying to construct a cell according to the

* Previously exposed. † Very damp day.

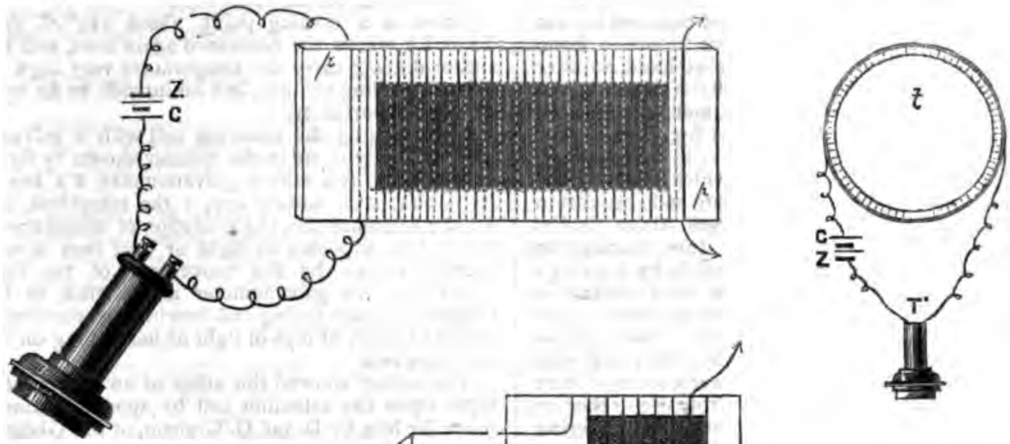


FIG. 1.

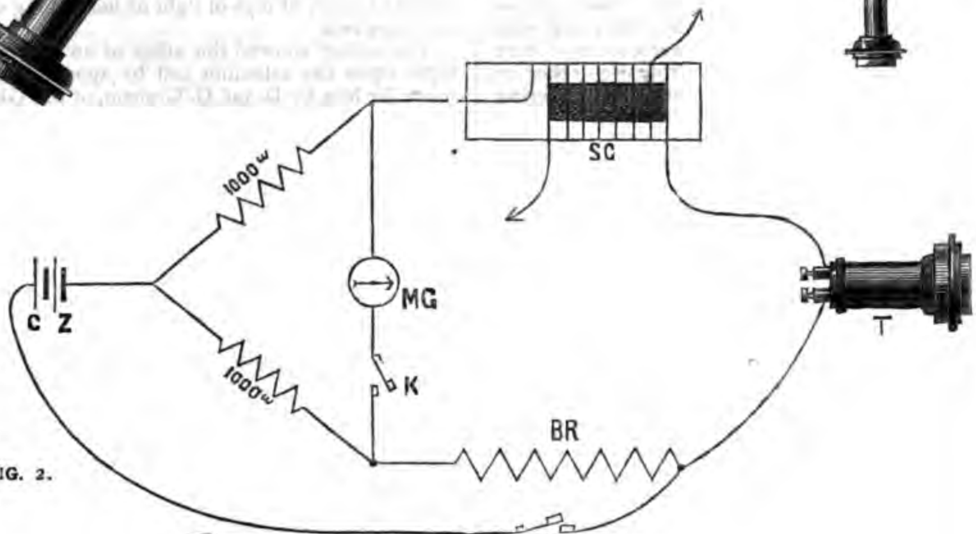


FIG. 2.

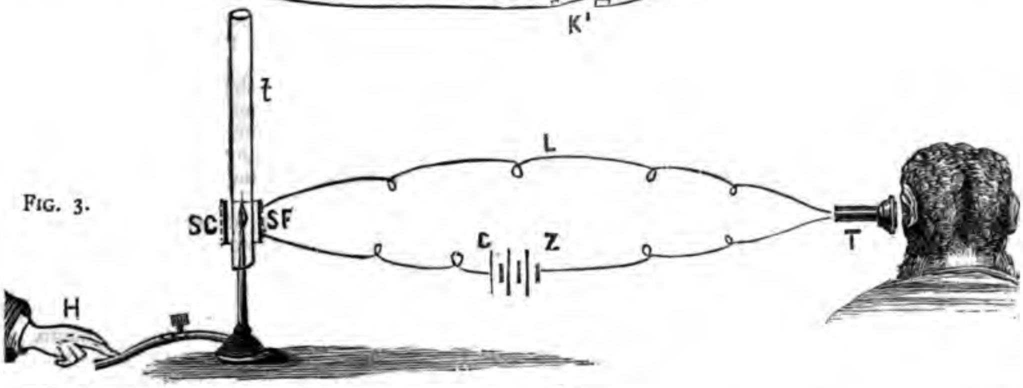


FIG. 3.

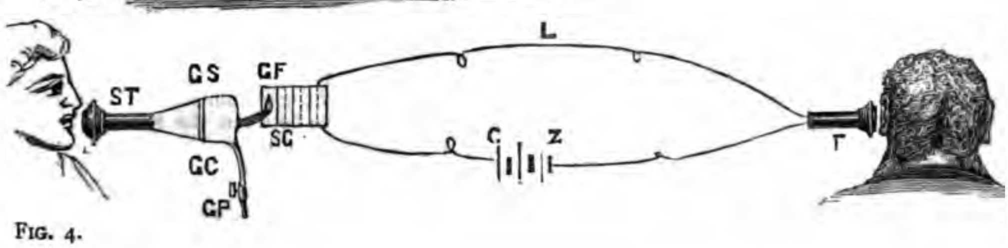


FIG. 4.

directions laid down by Professor Bell, the author was struck with the mechanical difficulty, time, and expense, necessary to make a good one, and he was also unable to make Mr. Shelford Bidwell's form, not having a screw cutting lathe at hand, so after trying several plans, he fell upon the simple, and at the same time quick and inexpensive, method shown in fig. 1. In this fig., *p* is a glass plate, or *t* a tube, ($\frac{1}{16}$ inch thick, $1\frac{1}{2}$ inches wide, and 4 inches long), upon which are tightly bound side by side two separate silk or cotton covered copper wires for about three inches along the middle of the plate or tube, leaving the ends of the wires free but tucked in by a sailor's serving-hitch, so as to keep them from slackening and unreeving. A red hot poker or iron is now applied to the darkened part, so as to burn off the insulating covering (silk or cotton) from that part (1 inch by 2 inches), and thus leave a series of bare parallel copper wires, separated from each other by the double thickness of the silk or cotton covering ($\frac{1}{50}$ inch). These copper wires are now carefully cleaned and brightened by glass paper, and the blank cell placed about 2 inches above a Bunsen burner, with a sheet of tin plate and mica intervening, so as not to burn the under side of the insulating cotton or silk, or inserted in an air bath.

The temperature of the blank cell is now raised to about 215° C., and a bar of selenium carefully rubbed over the surface of the bared wires (and parallel with them, not crosswise for fear of short-circuiting them by contact). Very shortly a coating of melted glossy selenium will cover the surface and the spaces between the bared wires; when such has taken place, allow the cell to cool and gently scrape off any superfluous selenium, until the wires almost appear, taking care not to use these scrapings for a fresh cell, for the author found to his cost and trouble, that the selenium seems to form an intimate mixture with the copper (*not* a selenite of copper, Cu Se), which readily conducts electricity, and upon using it for another cell, he short-circuited and spoilt it. The cell is now treated as explained for plan III., being gently heated to about 200° C., kept for some time at that temperature, and very gradually cooled and annealed. The surface of the selenium under this operation changes from a glossy to a dull slate colour, and the structure becomes crystalline. It is well to have the cell joined up during the whole operation with the Wheatstone Bridge and reflecting galvanometer, and to take frequent balances of the resistance, in order to ascertain how matters are progressing, and to note any sudden change or possible short-circuiting. The gradual cooling is easily performed by elevating the ring of the stand, and on which the cell is placed above the burner; the temperature of the surface selenium should be noted from time to time by thermometer. The author found that by keeping on a constant current from a battery of 6 Leclanché cells, the resistance fell more quickly and lower than without it during annealing, but he could not observe that any permanent beneficial effect was obtained by doing so, for after the battery was removed the resistance rose again.

With a stronger battery, 24 Leclanchés, he observed some cells polarise exactly like a fault in a submarine cable, the resistance decreasing with the current from the zinc pole and increasing with that from the carbon.

There is a turning point, about 213° C. (see Table I.), where the resistance again rises, and the author did not carry the temperature very high for fear of spoiling the cell, but he intends to do so at an early opportunity.

By joining up the selenium cell with a galvanometer and telephone in the manner shown by fig. 2, in which M G is a mirror galvanometer, K a key in its circuit, K[1] a battery key, T the telephone, and S C the selenium cell, the alteration of resistance of the cell on exposure to light or heat rays is very prettily shown by the movement of the light "spot" of the galvanometer and a click in the telephone; thus seeing and hearing are simultaneously the effect of rays of light or heat falling on the selenium cell.

The author showed the effect of an intermittent light upon the selenium cell by apparatus kindly made for him by D. and G. Graham, of the Glasgow Telephone Exchange, and a lime-light from Mr. White, the optician.

The apparatus consisted of a revolving disc, with ten equally pitched holes one inch in diameter, moving at any desired speed parallel to a fixed plate with a single hole, so that a beam of light projected from the lime-light upon this opening was free to pass and impinge upon the sensitive cell whenever any one of the holes in the revolving disc was opposite to that in the plate.

The result of this experiment was, that a note was heard in the telephone corresponding to the number of times per second that the light was free to pass through the opening in the plate and reduce the resistance of the selenium cell.

The author having had a call from Professor Blyth while he was experimenting with his selenium cells, the Professor suggested to him that he should try the effect of a singing gas-flame, which he accordingly did, and to his astonishment he was able to clearly reproduce in the telephone the exact note given out by the flame.

This arrangement is shown by fig. 3, in which L is the line wire, T the telephone, S C the selenium cell, S F the singing flame, *t* glass tube, and C—Z battery. The hand, H, by pressing the gas tube, could make the flame dance according to the Morse code or "peter click."

The selenium cell in no way touches the glass tube, but a clear air space intervenes between the two glass tubes.

Following up Professor Blyth's suggestion, the author had been fortunate in producing not only singing but speech by means of the gas-flame.

The arrangement tried by Mr. Jamieson at his lecture is shown by fig. 4, in which L is the line wire, C—Z battery (24 cells), T the telephone, S T the speaking tube, G S a diaphragm of goldbeaters' skin, G C a gas chamber, G P gas pipe, G F gas flame, and S C the selenium cell. The interchanges which take place between the speaker and hearer in this apparatus are two more than in Professor Bell's photophone, and consequently as far as a scientific phenomenon is concerned the experiment is all the more interesting.

Commencing with the operator we have—

1. Muscular movement of speaking, muscles, &c.
2. Vibration of air in speaking tube.

3. Vibration of thin diaphragm.
4. Contraction and enlargement of gas chamber regulating gas supply.
5. Up and down movement of gas-flame.
6. Rise and fall of resistance in selenium cell, with
7. Corresponding decrease and increase of battery current.
8. Consequent alteration in magnet of telephone.
9. To and fro movement of telephone disc.
10. Consequent vibration of air opposite ear of hearer, and
11. Vibration of the drum of his ear, &c.

All taking place almost instantaneously and with amazing truthfulness of reproduction.

The author concluded by remarking that had we only eyes of selenium, we should be enabled to see with many hundred times more celerity than we do at present.

The discussion was carried on by Sir William Thomson, Dr. Wallace, Prof. Blyth, Prof. McKendrie, and others, and they universally expressed themselves as greatly satisfied with the results not only shown at the lecture but by Mr. Jamieson to those who called upon him at his laboratory, where the above-mentioned gentlemen testified as to not only having heard singing but actual speech clearly reproduced.

We congratulate Mr. Jamieson on his efforts, and point out to our readers that the plans in figs. 3 and 4 seem to us to be very handy for lecture-room experiment and demonstration.

LANE FOX'S SYSTEM OF ELECTRIC LIGHTING.

THIS system, the invention of Mr. St. George Lane Fox, includes the lamp, the method of distributing the current, and the regulation of the current strength.

Fig. 1 represents the lamp. A is the luminous conductor or "bridge," mounted on the platinum wires, *b b*, which are fused into the glass tubes, *c c*. These tubes contain mercury, which surrounds the ends of the platinum wires. That part of the tubes, *c c*, into which the wires are fused is made of English lead glass, while the rest of the lamp, from the point, D, is made of German glass, for facility of construction. The luminous bridge, A, consists of a carbon thread of high electrical resistance. In practice, it is proposed to make them of 250 ohms resistance while in a state of incandescence; but, as will be seen immediately, their resistance can be adjusted so as to suit the electromotive force at which they are intended to work.

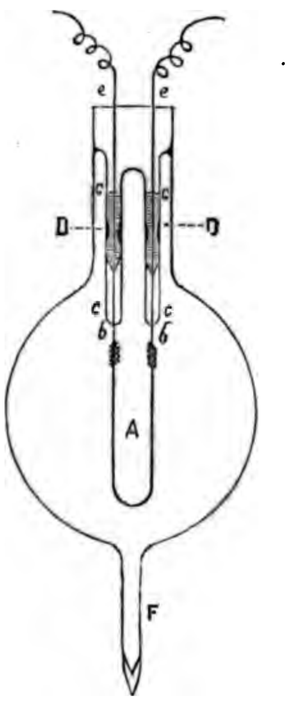


FIG. 1.

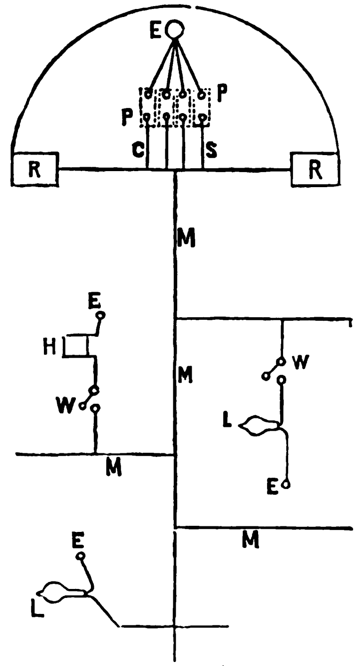


FIG. 2.

The lamps are ordinarily constructed so as to give a light of between 10 and 20 candles, but they can be made of any power, from 2 or 3 candles upwards; the quantity of light being directly proportional to the extent of luminous surface which the bridge exposes for radiation, and to the amount of energy expended. The temperature of the bridge is in all cases maintained as nearly as possible constant, as there is a point somewhere between the

fusing points of platinum or iridium at which, practically, the carbon filament undergoes no deterioration, but above which it is soon destroyed. This point varies with the degree to which the exhaustion of the globe is carried. With a very perfect vacuum it is possible to use a much higher temperature with safety, and so obtain a more economical light.

The ends of the bridge are thrust tightly into

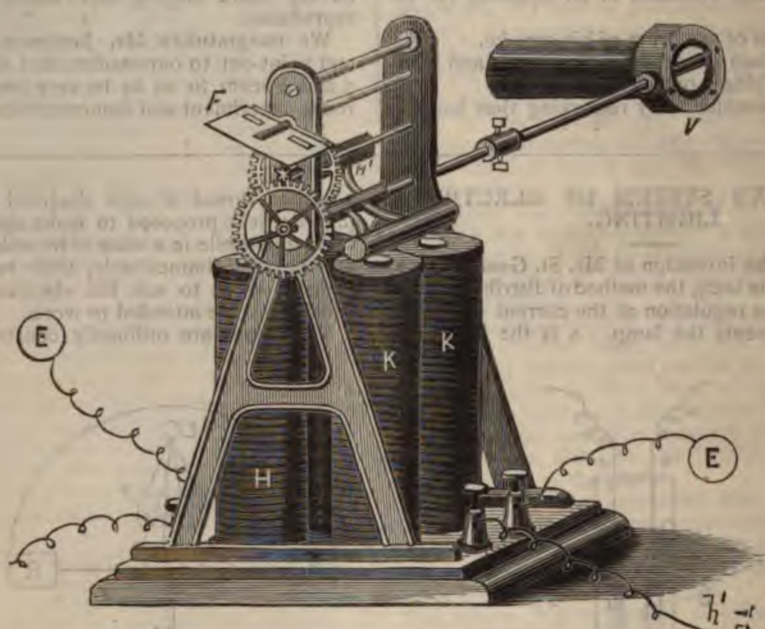


FIG. 4.

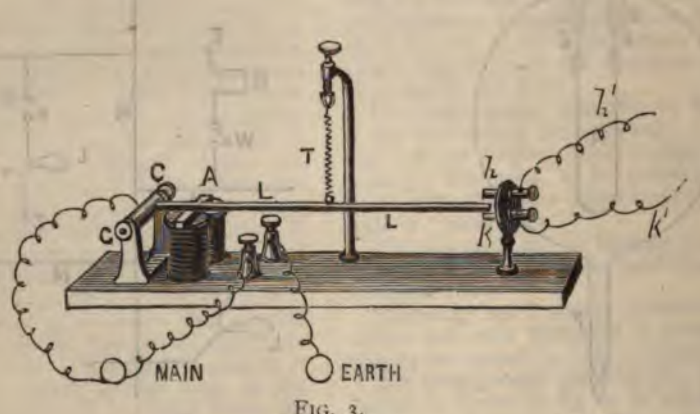


FIG. 3.

small spirals at the ends of the wires, *b b*, which are then covered with Indian ink.

The conducting wires, *e e*, dip into the mercury in the tubes, *c c*.

The lamp is attached to the exhausting pump by the tube, F.

When the vacuum is good, the current is turned on so as to raise the bridge to incandescence. The exhaustion is then continued for about two days.

The pump used in the manufacture of these lamps is new, and was devised specially for the purpose. It is very many times more rapid in its action than the Sprengel pump, and will produce a far more perfect vacuum.

The carbon filaments are prepared as follows:—A thread of flax or cotton is wound round a block of carbon or graphite of the required shape, and, having been properly secured, the whole is inclosed in a crucible and hermetically sealed; then raised to a white heat. The threads thus carbonised are then detached from the graphite block and mounted separately in suitable clips in an atmosphere of coal gas and benzole. A current is then passed through them so as to render them incandescent, when a deposit of hard gas carbon will be rapidly formed on their surface.

At first, owing to their high resistance, it is

somewhat difficult to obtain a sufficiently high electromotive force to raise the carbonised threads to a white heat. In order to overcome this difficulty, the following method has been adopted. The thread is joined up, as already described, between the poles of an electric generator giving a moderate electromotive force—very little current will pass through it, but, by making a short circuit through a large electro-magnet of low resistance, and then suddenly interrupting the short circuit, the extra current so formed will have sufficient electromotive force to momentarily raise the thread to incandescence, and a small deposit of carbon will be formed. This making and breaking of the short circuit is repeated several times, until the resistance is so far reduced as to allow a moderate electromotive force to pass sufficient current for incandescence. The deposition of carbon is then continued until the right conductivity has been attained.

The method of distributing electricity for the purpose of operating an indefinite number of lamps from a central station forms the most important part of Mr. Lane Fox's inventions and patents. By the proposed system, large conductors, which may be called electric mains, are to be laid down under the roadway, and proceed from central generating stations in a manner similar to the method now adopted for the distribution of gas. These electric mains are to be insulated by being imbedded in ozokerit or other suitable material, and are to ramify throughout a town or district to every point where a light is required.

Now these mains or branches are so connected with the electric generators at the central station that they are kept charged at a constant electromotive force, or, as it might be said, electric pressure, tending to develop currents in every direction to the "earth," and the lamps are connected at various points in multiple arc between the mains and the earth. In practice, an "earth" could be conveniently effected by means of gas or water pipes, or any uninsulated conductor forming a good electric communication with the generating station. One wire of every lamp throughout the system is connected to earth, the other wire to a switch, by which it can at pleasure be put in contact with the main. It is obvious that, whenever and wherever a circuit is thus completed a current will pass through the lamp, the strength of which will depend on the resistance of the lamp and the electromotive force of the main.

The energy expended will in all cases be inversely proportional to the resistance of a lamp, and directly proportional to the number of lamps at work. Fig. 2 represents the distribution arrangement, E represents the earth, M the main, L the lamps, W switch or electric tap.

Figs. 3 and 4 represent the regulator for maintaining a constant electromotive force in the mains. Fig. 3 is an electrometer or electro-dynamometer. It consists chiefly of an electro-magnet, H, of very high resistance, the ends of its coils being connected with the main and the earth. L is a lever pivoted at C, and in connection with the mains; h and k are contact pegs communicating by means of the wires, h^1 k^1, with the electro-magnets, H and K, fig. 4. The tension spring, T, exactly balances the attraction of the electro-magnet on the armature, A, at the normal electromotive force of the mains. It is obvious that the slightest increase or diminution of the electromotive force of the mains will bring the lever, L, in contact with one or other of the pegs, h and k, and so put into action one or other of the electro-magnets, H or K.

Should, therefore, the electromotive force fall from an increased number of lamps being put into operation, the magnet, H, will be put in action and an increased supply of steam will be allowed to pass through the throttle valve, V, to the engine working the generators, and the valve will continue to open until the normal electromotive force is re-established; the reverse action takes place when the electromotive force rises owing to a number of lamps being turned off.

By this means the power generated at the central station is made commensurate with the draught on the mains.

It is estimated that on a large scale (comparable to that of large gas works) energy could be retailed by means of the electric currents at a cost of less than a farthing a horse-power per hour, or a less cost than energy resulting from the combustion of gas, so that (says Mr. Fox) electricity could actually be used for heating more economically than gas, and without its accompanying disadvantages.

Mr. Fox states, that in lighting by "incandescence" *energy* can be used more economically than gas in the proportion of about 15 to 1, a statement which must be received with caution.

TELEGRAPHIC APPARATUS IN USE IN THE BRITISH POSTAL TELEGRAPH DEPARTMENT.

XXIX.

THE WHEATSTONE AUTOMATIC SYSTEM.

(Continued.)

THE AUTOMATIC DUPLEX.

IN general principle the Wheatstone Automatic Duplex system is similar to the Double current duplex, described in Article XI. The general arrangement of the apparatus at a "Down" station is shown by fig. 118. Each station has a "transmitter," a "receiver," a "galvanometer," a "rheostat," a "condenser," and a "duplex and single switch," besides, of course, the batteries.

If we compare fig. 118 with fig. 52 in Article XI., we shall see that the only difference between the two consists in there being a Wheatstone transmitter added, and in the relay being replaced by a Wheatstone receiver. As was explained in Article XXVI., the movement of the starting and stopping lever of the transmitter shunts the battery and "Down" line connections from the controlling mechanism of the apparatus on to the terminals connected to the double current key. In other words, the transmitter and double current key are interchangeable, and as both act in the same way the general working of the arrangement is similar to that of the ordinary double current duplex.

It will be seen that the condenser, C, is not connected directly between the terminals of the rheostat, R, but has a resistance, R_1, in its circuit. This

is done in order to retard the rate of discharge, so that its action may more nearly represent that which takes place in a long line. The actual arrangement of the condenser was explained and illustrated in Article XII.

The form of duplex and single switch shown in the figure is somewhat different from that indicated in previous articles, but it is the pattern which will be in future adopted, it having been found that the original form was liable to cause faults from bad contacts having been made. The new pattern is shown by figs. 119, 120, and 121; fig. 120 being an underneath view, and fig. 121 a side section. To terminals, A, B, *a*, *b*, *c*, and *d* (which correspond to those in the old form of switch), are connected the radial springs seen in fig. 120; these springs press against a disc with metal pieces, *m*, *n*, insulated on ebonite. The whole disc is joined to the switch handle. In the position shown (handle turned to "Duplex"), terminals B and C are connected by their respective springs resting against the brass piece, *n*. Also the springs of terminals A and *b* are similarly connected by the brass piece, *m*. Springs *a* and *d* are disconnected. If now the switch handle be turned to "Single," then the brass piece, *n*, connects springs B and *d*, and the piece, *m*, connects A and *a*, leaving springs C and *b* disconnected. The switch acts precisely in the same way in fact as the old form, that is, as regards the connections; these connections, however, are made by good rubbing contacts, and are not likely to fail.

Referring again to fig. 118, it may be pointed out that the switch of the double current key, which is of the ordinary form, is shown in the position for "sending."

Since the Wheatstone automatic instrument was first introduced various improvements and modifications have been made. Some of these modifications, which were considered improvements, have been abandoned as unnecessary; amongst these may be mentioned working with "compensated currents." It will have been seen in all the diagrams of the transmitter instrument that two terminals, R_1, R_2 (fig. 88), are provided, which are kept joined across with a strap. Now, if these terminals be disconnected, then every time the pins, p_1 or p_2, break contact with the arms, A and B, at that moment the circuit between U and D becomes broken. Now, it was pointed out that when the disc, D, became thrown over to one side or the

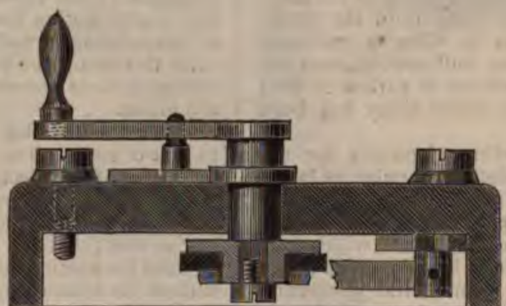


FIG. 121.

FIG. 119.

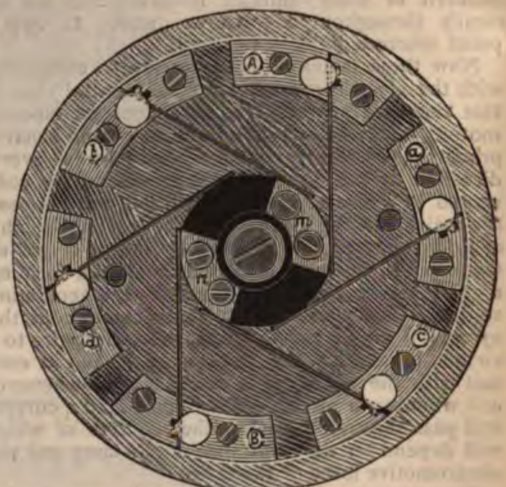


FIG. 120.

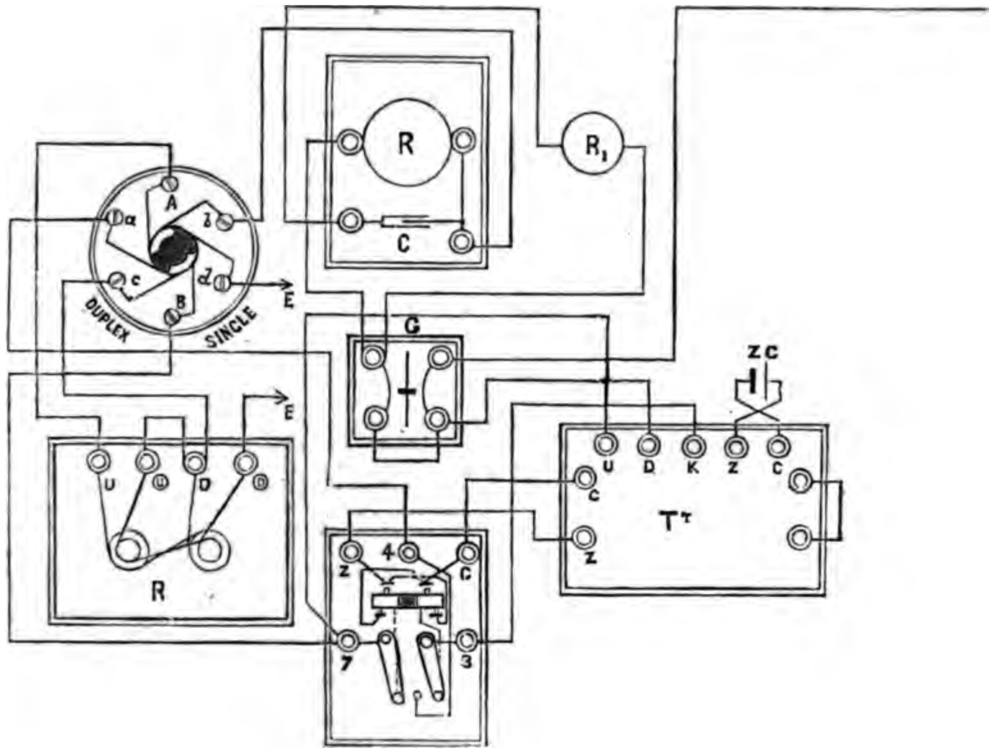


FIG. 118.

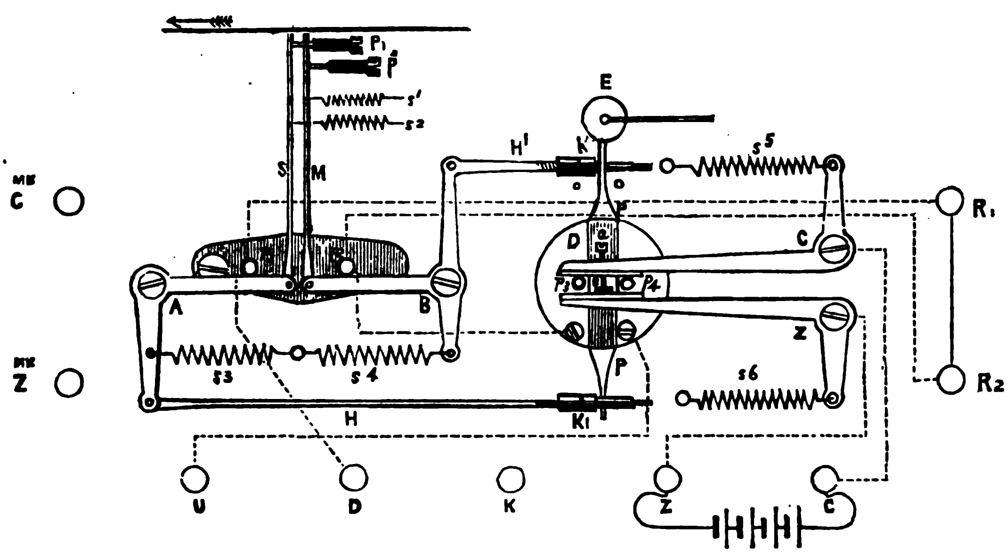


FIG. 88.

other, then a corresponding current was sent out to line, which current remained on until the motion was reversed, and when the latter took place, a current in the opposite direction flowed. Now, if immediately after the disc, D, is thrown over in one direction or the other, one or other of the pins, p_1, p_2, leaves off making contact with A or B, which will be the case if the rods, S or M, cannot rise, then the current sent will be cut off, as there is no circuit between p_1 and p'_2, consequently the disconnection of R_1 and R_2 causes intermittent currents only to be sent out to line. If, however, R_1 and R_2 be joined by a resistance, then the currents will not be entirely cut off when the pins, p_1 or p_2, leave off making contact, but they will be diminished in strength according as the resistance in question is of a high or low value. Experiments proved that in certain cases an increased speed was obtained by this arrangement, the resistance between R_1 and R_2 being suitably adjusted. At the present time, however, with electro-magnets of a small size in the receiver, no benefit is found to arise by working with compensation, and this has consequently been abandoned.

Notes.

IN our article on Tele-photography in which Mr. Shelford Bidwell's ingenious apparatus is described, we seem to infer that a similar apparatus had been invented by Bakewell and D'Arlincourt, and that this had been reinvented. This of course was not our intention. What we intended to explain was, that the mechanical *idea* of copying was similar in the two cases though the *means* by which the copying was effected was entirely different. In the case of the Bakewell and D'Arlincourt apparatus the currents are *intermittent*, in Mr. Bidwell's invention *variation* is employed, which is entirely a novel idea in chemically marking telegraphs; also the employment of light, acting on selenium to produce the variation for the purpose of copying, is quite new.

WE have had the pleasure of inspecting the electric light system of the Electric Light Agency, invented by Mr. F. Joel. The whole arrangement of the apparatus is eminently satisfactory, and seems to solve the question of the adaptation of the electric light to domestic purposes in a most satisfactory manner. The light is as steady and as soft as can be desired, and a great contrast to gas illumination. The lamp fittings are most ingenious and thoroughly well adapted for the purpose intended. Altogether the system promises well.

TELEGRAPH LINES IN CHINA.—A contract has been entered into between the Chinese Government and the Great Northern Telegraph Company of Copenhagen, for the establishment of a telegraph land line between Shanghai and Tientsin, the harbour for Pekin. The work has to be done for the Chinese Government, but under the special superintendence of the Company's Danish telegraph engineers; and the Company further supplies all the materials required for the undertaking. The work has to be commenced in the month of May this year, and the line will extend over about 1,000 English miles. For the present it is the intention to establish 9 or 10 stations on the line. The contract further provides that a telegraph school, for educating Chinese for the telegraph service, in all its branches, has to be opened this spring, under the guidance of two teachers nominated by the Company; at the opening of the school there will be thirty pupils, which number will be increased gradually. On the signing of the contract, an amount equal to one-third of the Company's outlays has been paid to the Company, as an earnest money. The remainder will be paid gradually as the line is being completed. The opening out of an inland telegraph net in China is owing mainly to the exertions of the well-known statesman Li Hung Chang, Viceroy of Tientsin, who obtained a decree from Pekin to this effect in October, 1880.

THE following letter has been circulated by the Commissioner-General of the Exposition Internationale d'Electricité :—

"Paris, March 4th, 1881.

"Sir,—The British Government, though declaring the full interest which it takes in the great scientific and industrial enterprise initiated by France, has decided that it sees no necessity for appointing a special Commissioner to take measures with regard to the participation of British subjects in the International Exhibition of Electricity which is to open in Paris on the 1st of August next, in the Champs-Elysées Palace. The Government of the French Republic is nevertheless disposed to welcome all British subjects wishing to participate in the Exhibition.

"In compliance with Art. 12 of the General Regulations, of which I inclose a copy, I beg to place myself unreservedly at your disposal to give you immediately whatever information you may think desirable, and to attend officially to your interests if, as I hope you will, you resolve to send any articles to this Exhibition. In that case, I should be thankful if you would be so kind as to fill up, sign, and return to my address, the printed form of demand of admission which accompanies the copy of the General Regulations.

"You will be placed, in every respect, on the same footing as the French exhibitionists, whom I have to attend to individually, and I beg to assure you of the favourable dispositions of the French authorities, who will make it their duty to offer you the most courteous and impartial hospitality.

"I shall manage to form a special section for the group of English exhibitionists. In order to facilitate my task and secure for it the best conditions of success, I take the liberty of requesting you to forward your demand within the briefest delay possible. My answer, with all the details you may require concerning the despatching and placing of the articles which you wish to exhibit, will promptly follow.

"I am already empowered to let you know beforehand that the Exhibition rooms and dependencies shall be considered as real custom-house stores, so that all the articles sent there shall be exempt from the duties to which they might otherwise have been liable. Should they remain in France after the closing of the Exhibition, the usual duties will then, of course, be exacted of them.

"The French railway companies have consented to an abatement of 50 per cent. on the ordinary rates of transportation, whether by fast or by slow trains, for all packages or boxes forwarded to the Exhibition hall, and bearing the official labels, with which I shall have to provide you, agreeably to Art. 15 of the General Regulations. The application of these abated ra[illegible] shall be made as follows: the packages or boxes sh[illegible] pay the full price for transportation to Paris, but sh[illegible] be taken back free of charge on presentation of a cer[illegible]ficate signed by me, and showing that the articles have

really been exhibited. Drayage and other incidental expenses from the railway terminus in Paris to the Champs-Elysées Palace will be borne by the owners of the goods.

"A special law will secure all the extra guarantees desirable for exhibited articles made abroad but patented in France.

"Several British subjects have already applied to me concerning the Exhibition, and I am happy to hear that the Postmaster-general has been authorised by the British Government to exhibit in the name of the latter. I trust this honourable example will be followed by all the industrial electricians of the United Kingdom.

"I remain, Sir, yours respectfully,
"THE COMMISSIONER-GENERAL."

AT an ordinary meeting of the Royal Society of Edinburgh, held on February 21st, Sir William Thomson stated the results of certain experiments made by M. August Witkowski on the "Effects of strain on electric conductivity." The question to which M. Witkowski set himself to find an answer was, whether taking a metallic body—brass being the one chosen in his experiments—and submitting it to tension so as to elongate it in one direction and condense it in the opposite direction, the conductivity of the metal would be equal in all directions; or, if not, what would be its variation. The answer he had found to the question was that the conductivity was greater in the line of condensation and less in the direction of extension. He had also accurately measured the results obtained. Sir William next explained a communication of his own, "On the effect of moistening with water the opposed metallic surfaces in the Volta condenser, and of substituting a water arc for a metallic arc in the determining contact." The experiments, the results of which were given in the communication, were, he said, inspired by the attempt to explain away Volta's fundamental experiment by suggesting that the result might be due to the presence of moisture between the zinc and copper plates. Now the result of his experiment was simply the very opposite of what that suggestion seemed to imply, for the effect of the substitution of a water arc for a metallic arc in the determination of the contact was as near as might be electrically null.

OWING to the frequent interruptions which have occurred recently to telegraphic communications between Shetland and the mainland, a numerously-signed petition from the inhabitants of Lerwick has been presented to the Post-Office authorities, praying them to grant direct communication with the mainland.

UNITED TELEPHONE COMPANY, LIMITED, v. D. and G. GRAHAM, GLASGOW.—In this process, which came before the Court of Session, Edinburgh, on February 16th, the United Telephone Company, Limited, ask the Court to interdict the respondents, who are telegraph engineers and contractors, from infringing certain letters-patent obtained by Edison and Crossley for the manufacture of telephones. The respondents say that the instruments used by them are not a contravention of the complainers' letters-patent, and they say also that the specification in the letters-patent is faulty, and does not distinguish between what was old and new at their date and what is claimed as new; and that the invention claimed by the complainers is not new, and is not useful, advantageous, or beneficial to the public. They further explain that the telephones used by them are all made by and purchased from the Gower-Bell Telephone Company, Limited, between whom and the complainers an action raising this very question is now pending in the High Court of Chancery, and they (the respondents) therefore ask that this case should be sisted pending the issue of the other case. The Lord Ordinary, after hearing counsel, refused interim interdict, but passed the note to try the question raised, and ordered the respondents to keep count of all instruments sold, used, or let for hire by them pending the decision of the case.

EXPERIMENTAL RESEARCHES ON MAGNETIC COERCITIVE POWER.—H. Külp.—If very short rods of 10·50 mm. in length and 8 mm. in thickness are subjected to the action of the current in a spiral coil and the current is suddenly interrupted there appears a reversal of the magnetisation, especially if the rods are very hard and the magnetising power feeble.—*Wiedemann's Beiblätter.*

NEW EARTH-COMMUNICATION FOR ELECTRIC TELEGRAPHS AND LIGHTNING-CONDUCTORS.—J. Grüner's Patent.—An essential condition of every electric conduction is the presence of a perfect connection with the ground, in order to facilitate as much as possible the passage of the current into the earth. This condition has been hitherto realised only by the costly expedient of copper plates, and even then only partially, because such a plate a few days after it has been laid in the earth becomes oxidised in many places, and with this increasing oxidation its conductive power sinks down to a certain limit. But this limit is not always constant and involves a continued variation in the current. If iron plates are employed the above evils are still more strongly and speedily manifested, and various perturbing phenomena are produced, especially if the nature of the soil is unfavourable and powerful constant currents are employed. The cause of these irregularities is generally sought in the various kinds of apparatus or in the batteries, though in most cases it is due to an imperfect earth-connection. J. von Grüner, telegraphic engineer to the Vorarlberg Railway, has devised an unoxidisable earth-connection, which is at once cheap, permanent, and possessed of great conductive power. It is also well adapted for the earth-connections of lightning-conductors. — *Oesterreichische-Ungarische Post.*

BEHAVIOUR OF NON-CONDUCTORS.—By M. Baille.—The author shows by means of the replenisher that insulators which have been heavily charged by contact with an electrified body are never quite discharged by contact with a conductor. The final residuum is always constant for one and the same initial potential.—*Wiedemann's Beiblätter.*

ELECTRIC RESISTANCE OF GLASS.—According to experiments conducted at the Imperial College of Engineering at Tokio, Japan, by the professor of telegraphy, the variation of the electric resistance of glass is slower when the glass is cooling than when it is being heated, and the resistance of a piece of glass can be considerably increased by raising it slowly to a high temperature and then cooling it slowly.—*Il Progresso.*

ON THE MAGNETISABILITY OF IRON AT HIGH TEMPERATURES.—By A. WASZMUTH.—A bar 222 cm. in length, and 2·6 mm. in thickness after ignition, was magnetised by currents of different strength in a coil 260 mm. in length, in which the magnetising power did not vary more than 4 per cent. from the middle to the end of the bar. Its momentum, after compensating the action of the coil by a second coil, was read off in a mirror-compass. The bar was then heated from 20° to 146° C. by means of a current of hot oil. After the

temporary magnetisation, the magnetising current was gradually reduced to null by the introduction of greater and greater resistances in order to measure the permanent magnetism, and was then demagnetised by means of weaker alternating currents. The author cites the following results, which were confirmed by experiments with three other rods. With smaller magnetising powers the bar has at higher temperatures a greater magnetisability, the turning-point cccurs for much smaller magnetising powers, and the maximum for a change of temperature of 118° C. is smaller by about 3 per cent. The ratio of the maximum to the abscissa of the turning-point is always greater. If the curves of magnetisation at the temperatures employed, $t = 20$ and $t^1 = 130—146°$, are determined, taking the momenta as abscissæ and the magnetising functions as ordinates, the abscissa of the average point is about three-quarters of the maximum for the time being. On repeated heating and slowly cooling, the curves for magnetisation at low temperatures move upwards and at high temperatures downwards, so that they approximate up to a certain limit.—*Wiener Berichte.*

INFLUENCE OF TEMPERATURE ON THE DISTRIBUTION OF MAGNETISM IN A PERMANENT MAGNET.—By G. Poloni.—In cylindrical steel magnets of 50 cm. in length and 6·5 mm. in thickness, which were repeatedly heated to 250° C., and cooled down to the ordinary temperature, the distribution was found to be altered after the heating. At the distance of 14—15 cm. from the north pole the final value is greater than at 25 cm., both absolutely and in relation to its original state.—*N. Cim.* 1880, p. 103.

A NEW EXPERIMENT ON MAGNETIC ATTRACTION.—By E. Piazzoli.—The author shows that the attraction of elder pith by the magnet as observed by Ader depends probably on the presence of small particles of iron.—*N. Cim.* 1880, p. 100.

IMPROVEMENT IN GALVANIC BATTERIES.—By R. Chapman Anderson. (German Patent, No. 10,174 and *Zeitschrift für Ange. Electricität*, 1880, p. 350).—In an ordinary zinc-carbon element the zinc is placed in contact with solution of sal-ammoniac and the carbon with dilute hydrochloric acid, whilst into the latter liquid is plunged a tube, perforated at its lower part and filled with a mixture of equal parts of bichromate of potash and oxalate of chrome and potash (chromium-potassic oxalate). By immersing the tube to different depths the concentration of the solution and the efficiency of the couple are modified. For elements with one liquid only the last solution is employed. If fumes are given off the surface of the liquid may be covered with a thin pellicle of oil, soot, or wood-charcoal.

THE *Oesterreichische-Ungarische Post* continues to criticise severely the organisation of the telegraphic service in the Austrian empire.

DEFORMATION OF A BENT ELASTIC CONDUCTOR UNDER THE INFLUENCE OF TERRESTRIAL MAGNETISM.—H. Niemoeller.—A thick elastic wire from 1·5 to 2 metres in length, and 1 mm. in thickness, is bent in the middle at a right angle and secured at its ends by means of set screws. If the wire lies in the plane of the magnetic meridian it is deflected when a current is passed through it, and on repeated reversals of the current it begins to oscillate. If the action of the earth is neutralised by means of a magnet, and if a second wire is fixed parallel with the first, the phenomena of attraction and repulsion can be demonstrated in either.—*Wiedemann's Beiblätter.*

GRAPHIC INVESTIGATIONS ON GALVANOMETER COILS WITH REFERENCE TO THE GREATEST POSSIBLE SENSITIVENESS.—M. Th. Edelmann.—The author considers galvanometers with circular windings. If the radius of a winding is r, and its distance from the middle of the needle, e, then, since its resistance is proportional to its radius, it follows that the indication on the scale produced by a given electromotive force will be

$$g = \frac{2\pi r}{(e^2 + r^2)^{\frac{3}{2}}}$$

If for a given constant, e, the r are plotted out as abscissæ, and the e as ordinates, the corresponding curve shows the efficacy of the single windings. If the curves obtained for the different e are cut by lines parallel to the axis of the abscissæ, we find the windings of equal value.—*Carl's Repertorium*, 16, p. 670.

IRIDIUM FOR ELECTRIC LIGHTS.—The latest material offered for an incombustible "burner" for the electric light is iridium. Mr. Holland, gold pen maker, of Cincinnati, claims to have discovered a flux by means of which he is able to fuse iridium in an ordinary draught furnace. He casts the metal in any shade desired, and in bars or ingots weighing as much as ten ounces. The metal thus fused and cast defies the file and resists all acids. The only mechanical way of cutting it is by friction with a copper wheel charged with diamond dust or fine corundum. Mr. Holland claims, further, that the cast iridium makes suitable "burners" for the electric light, and that so used the metal is durable without protection from the atmosphere.—*Scientific American.*

THE Commissariat-General of the Paris International Exhibition of Electricity are anxious that all requests for space be sent in as soon as possible, and not later than March 31st.

SOCIETY OF ARTS.—The series of Cantor Lectures, being delivered before the Society of Arts by Professor W. G. Adams, F.R.S., on "The Scientific Principles involved in Electric Lighting," commenced on Monday, the 7th March, and will continue on the three following Mondays, ending March 28th. The first two lectures will be mainly introductory, and will deal with such subjects as the production, regulation, and measurement of electric currents, and the action of magneto-electric and dynamo-electric machines. In the third and fourth lectures it is hoped to show a large number of illustrations of the various systems of electric lighting. The new incandescent lights of Swan and Lane Fox will be exhibited at the fourth lecture.

THE postal telegraph department have issued their accounts, from which it appears that during the past year a profit of £354,030 has been realised, which is equivalent to a dividend of 3·36 per cent.

AT the Electrical Exhibition the Publishers' Union, under the direction of MM. Hachette, will establish an exhibition of electrical publications, and a reading room, into which will be admitted all the scientific papers of the world, irrespective of their language.

GENERAL ANSON STAGER, vice-president of the American Western Union Telegraph Company, has resigned his office.

A SERIES of "Notes and Queries on Electricity and Electro-magnetism and their Applications," by Mr. D. Lockwood, are being published in an American contemporary, *The Operator*. The articles are good of their kind, but a very free use appears to be made of

well-known English work on electrical testing, in working them up.

EDISON has just been beaten in the Patent Office, in the suit regarding the invention of the Edison as against the Maxim electric light, both of which are similar. The Examiner of Interferences has decided that Edison was not the first inventor, and that the patent must be issued to the United States Electric Lighting Company, representing the Maxim claims. This is the famous platinum lamp, which created such a panic in gas stocks about two years ago, and sent the stock of the Edison Company up to an almost fabulous figure. It is claimed by the United States Company that other important contests relating to incandescent lighting will now be decided in its favour, as it was the first in the field in this country.—*Operator.*

MANY physical treatises still assert that moist air conducts electricity, though Silberman and others have proved the contrary. An interesting experiment bearing on this has been described lately by Prof. Marangoni. Over a flame is heated some water in a glass jar, through the stopper of which passes a bent tube to bell-jar (held obliquely), which thus gets filled with aqueous vapour. The upper half of a thin Leyden jar charged is brought into the bell-jar, and held there four or five seconds; it is then found entirely discharged. That the real cause of this, however, is condensation of the vapour on the part of the glass that is not coated with tinfoil (the liquid layer acting by conduction) can be proved; for if that part of the jar be passed several times rapidly through the flame, so as to heat it to near 100° C., before inserting in the bell-jar, a different effect will be had; the Leyden jar will give out long sparks after withdrawal. This is because the glass being heated no longer condenses the vapour on its surface, and there is no superficial conduction, as in the previous case.—*English Mechanic.*

PORTABLE BATTERY FOR ELECTRO-MEDICAL USES.—W. E. Klein, of Stuttgart, has designed a new battery for such purposes. The elements consist of slips of zinc and rods of carbon. The exciting fluid consists of 300 parts water, 45 chemically pure sulphuric acid, 10 bichromate of potash and 2 persulphate of mercury. In this liquid the zinc slips remain permanently amalgamated, but after use they should be at once lifted out, which is very easily effected by means of screws. The management of the apparatus is exceedingly simple, and failure of action is impossible. Such batteries are fitted up with 10, 14, 20, or 32 elements.—*Zeitschrift Angewandt Electric.*

CURIOUS PROCESS.—The Hamburg-Heligoland telegraph line was entangled with the anchor of a ship in August, 1880, in the latitude of Neuwerk, and cut by order of the captain. An action for damages brought by the company against the owners of the ship has been decided in favour of the defendants. The company has appealed to a superior court.—*Oesterr.-Ungar. Post.*

ELECTRIC FIRE ALARMS.—If self-acting fire alarms are to afford really any protection, they must be distributed in sufficient numbers in the premises to be secured. To render this possible it is again necessary that the apparatus, though perfectly trustworthy, should still be cheap. For this purpose, thermometers, in the strict sense of the word, have been abandoned in favour of thermoscopes. The latter are generally arranged as follows:—A spring or a weight tends to produce electric contact, but is opposed by the solidity of a thermoscopic substance. On the approximation to a temperature of which warning is to be given, the substance melts or softens, gives way, and electric contact is effected with more or less completeness. By means of a suitable selection of thermoscopic substances the temperature which effects contact can be adapted to individual cases. On this principle depend the instruments of Bréguet, Fein, and Dupré. In every such apparatus it is of the greatest importance that the contact should be perfectly trustworthy. In this respect a fire alarm constructed some years ago by Dr. Heeren, of Hanover, seems to us very remarkable. The arrangement of the apparatus is essentially as follows:—An iron hook, turned upwards at a right angle is fixed in the wall of the room to be protected. Upon it is fixed a perforated disc of rubber, which bears a disc of lead, also perforated, and to which a copper wire is soldered. A weight of 1 to 2 kilos., also perforated in the middle, is fixed on the rod. The weight has below a gilded point, and is lifted up so high by means of a thread that the gilt point is at the distance of 15 cm. from the leaden disc. At the end of the thread is a ring made of Wood's fusible alloy, and hung on a nail. As soon as the dangerous temperature is reached the ring gives way, and the weight drives its gilded point forcibly into the leaden disc, thus effecting a perfect contact. The apparatus, which is sold for 1s. 6d., was shown in 1878 at the Hanover Trade Exhibition. The Hanover "Rubber-card Company" uses a number of these instruments with the best results.—*Zeitschrift Angewandt Elect.*

ON THE DANGER OF LIGHTNING FROM TELEPHONE CONNECTIONS.—The Cantonal Government of Zürich, having been applied to by a telephone company for permission to fix the supports of insulators on the tops of certain public buildings, applied to Prof. Kleiner for an opinion. The following is a summary of the chief points in his report:—

1. The danger of lightning in houses over which telephone wires are stretched is not increased but lessened if the total conductivity of a wire is approximately equal to that of a lightning-conductor. This condition is not always fulfilled under existing arrangements. It may be insured by very simple arrangements, such as the introduction of a special wire for the conduction of lightning wherever the number of wires of two millimetres in thickness running in the same direction is less than 60. This should be insisted upon in all cases. Single connections running along the houses should be stronger than at present—at least as strong as telegraph wires.

2. As the properties of a telephonic plexus for attracting and conducting lightning extend over far wider tracts than those of a lightning rod, a strict regulation of their make and condition is necessary.

The use of telephones should be suspended during thunder-storms.—*Neue Zurich Zeitung.*

DR. UELSMANN'S ZINC-IRON BATTERY.—The batteries hitherto used for the production of powerful galvanic currents are the zinc-platinum, the zinc-carbon, and the zinc-iron. Each of these has its peculiar advantages and defects, and the electromotor forces of the three differ but little. In published accounts we find very notable discrepancies, which are readily explained by the circumstances that the experimentalists did not construct their batteries of perfectly pure materials, that they employed acids of different strengths, and measured the resulting forces by different methods. The application of the zinc-platinum battery is restricted chiefly by the high price of platinum. The zinc-carbon battery is cheaper, and is still much used

in the form designed by Deleuil, with zinc cylinders and prisms of carbon. It is preferable to press the copper vanes which are soldered to the zinc cylinders by means of iron clamps. The contact with the carbon is injured by the nitric acid rising up through the porous mass, hence it is necessary to take out the brittle carbons and free them from acid by steeping in water. The zinc-iron battery, which is still cheaper, is free from these evils. Still it has a bad property, the consequences of which cannot always be got over in regular working. In consequence of the continued liberation of hydrogen at the iron electrode the concentration of the nitric acid gradually decreases, and a point is finally reached when the iron is stripped of its protective layer of oxide, and is dissolved with strong effervescence. The nitric acid then passes into the glass cells, and the battery must at once be taken to pieces—an unpleasant task—large volumes of suffocating hyponitrous gas are evolved. Although the first cost of the zinc-iron battery is smaller than that of the others, the zinc-carbon battery is often preferred on account of the inconvenience just mentioned. Dr. Uelsmann's invention completely overcomes this difficulty. By adding silicon to the cast-iron he prevents the iron electrodes from being suddenly thrown into the active or soluble state. As might have been assumed, an experimental examination has shown that this addition of silicon has no perceptible effect on the electric properties of the electrodes, and 10 per cent. more of the acid is capable of being utilised. The danger of boiling over is completely avoided. The silico-iron electrode is therefore a notable step in the construction of hydro-galvanic batteries.—*Zeitschrift Angewandt Electr.*

ELECTRIC LIGHTING IN THE CITY.—At a meeting on March 8th of the City Commissioners of Sewers at Guildhall, at which Mr. Ashby presided, the Streets Committee reported that the Electric and Magnetic Company (Jablochkoff's system) had expressed their regret that in consequence of legal and other difficulties they were not in a position to seal the contract for the electric lighting of a portion of the City, in accordance with their tender of the 20th October last. The Committee had consequently made arrangements with the Electric Lighting and Power Generation Company (Lontin System) to light the district in question for a year at the same cost, £2,930. The district includes Southwark Bridge, Queen Victoria-street, Queen-street, and Queen-street-place. As far as this district was concerned, the experiment would be delayed a month, commencing May 1st. The other two districts to be lit by the Siemens and Brush system would be commenced on May 1st. The report was carried.

JOHNSON'S PATENT TRANSMITTER.—We are informed that this instrument, in combination with Bell's receiver, is at work at Sheffield on the Telephone Exchange, and on long private wires, and is giving the greatest satisfaction. No adjustment is required, and the tone is exceptionally loud and clear.

THE Annual report of the American Commissioner of Patents for the year ending December 31, 1880, gives the business of the year as follows:—Applications for patents for inventions, 21,761; applications for patents for designs, 634; applications for reissues of patents, 617; total, 23,012. Patents issued, 13,441; patents reissued, 506; patents expired, 3,781; trademarks and labels registered, 533. Of the 13,441 patents issued during the year, 12,655 were to citizens of the United States, and 786 to foreigners. There was received during the year for patents, copies of records or drawings, and from other sources, an aggregate of $749,685.32. The total amount expended was $538,865.17, leaving a balance of $210,820.15. On January 1, 1880, there remained $1,420,806.56 to the credit of the Patent Fund, which, added to the surplus of 1880, makes the amount to the credit of the Patent Fund on January 1, 1881, $1,631,626.71.

THE Paris Exhibition of Electricity will contain a number of curiosities. M. Salignac will present to the Director-General a plan for cooking by electricity in the grill-room of the restaurant. This plan should provide useful work during the day for the magneto-electric machinery, and test its warming power. M. Michels, an American residing in Paris, has patented a revolving carbon which can be rolled like an ordinary conductor.—*Nature.*

M. MARCEL DESPREZ has been created a Knight of the Order of the Legion of Honour.

IT is stated that Mr. Silbiger has contracted for the construction of an electric railway between Shipping Point and the camp at Aden.

ACCORDING to the *Bulletino Telegrafico* there has been put up for experiment in the Central Office at Rome a Hughes machine with a Humblot hydraulic motor.

ELECTRIC HOIST BY SIEMENS AND HALSKE.—The transfer of power by the means of the dynamo-electric machine has met with a new application in an elevator for persons exhibited at Mannheim, by Siemens and Halske, in which electric force is substituted for hydraulic force or for the action of a rope. The hoist serves in the Industrial Exhibition of Mannheim to raise visitors to a balcony of the height of about twenty metres, and in the course of a few weeks has been made use of without inconvenience by about 8,000 persons, with a speed of about fifty centimetres per minute. The arm of a lever within reach of the hand of a person standing on the platform, renders it possible to change at will the direction of the movement by turning the arm to the right or the left. If the lever is held in the intermediate position the current is interrupted and the movement is stopped. The commutator acts automatically at the two extreme points of the journey.—*Telegrafista.*

APPLICATION OF ELECTRICITY TO WIND UP CLOCKS. —A watchmaker of Copenhagen, L. Sonderburg, has constructed a clock which is said to wind itself up by the aid of an electric current. According to the *Wiener Allgemeine Zeitung*, the spring of the clock is kept constantly wound up by means of an electro-magnet. This magnet, therefore, has the duty of superseding the periodical winding-up of the spring or the weight. The idea is not novel, as a similar application of electricity has been already tried with advantage in certain forms of telegraph apparatus in order to dispense with the trouble of winding up the motor (spring or weight) every few minutes. A watch on this principle will require a somewhat strong battery, which adds to its cost without rendering it more trustworthy as a timekeeper or improving its appearance.—*Oesterreichische-Ungarische Post.*

THE Glasgow Town Council have accepted the offer of the Crompton Lighting Company, Limited, to light, for their inspection, George Square, by means of two large electric lights, for one week free of charge. If the light is deemed satisfactory the company offer to light the square for three or six months at the respective rates of £60 or £120.

New Patents—1881.

539. "Electric lamps." E. G. BREWER. (Communicated by T. A. Edison.) Dated February 8.

542. "Telephonic apparatus." J. SAX. Dated February 8.

562. "Improvements in carbon burners for incandescent conductors for electric lamps, and in the means and methods of manufacture and treatment thereof, partly applicable to the manufacture of other carbon articles." P. JENSEN. (Communicated by T. A. Edison.) Dated February 9.

579. "Electro photographical receivers for telegraphs." H. CHAMEROY. Dated February 10.

607. "Improvements in apparatus employed for and in telegraphic or telephonic communication." P. M. JUSTICE. (Communicated by J. V. M. Bartelons.) Dated February 11.

639. "An improved process or method of preparing carbon and other conductors to be used for electric lighting and other purposes." W. R. LAKE. (Communicated by H. S. Maxim.) Dated February 15.

663. "Telephonic apparatus and signals therefor." P. M. JUSTICE. (Communicated by H. R. Miller.) Dated February 16.

667. "Railway point and signal apparatus." J. SAXBY and J. S. FARMER. Dated February 16.

715. "Improvements in and connected with electric lamps, parts of which are applicable for other lighting and heating purposes." J. G. TONGUE. (Communicated by A. Lacomme.) Dated February 18.

732. "A magnetic fire annihilator." W. WALKER. Dated February 21.

760. "Telephones." E. W. ANDERSON. (Communicated by J. Goodman.) Dated February 23.

768. "Connecting the ends of the carbon to the conducting wires in electric lamps." E. G. BREWER. (Communicated by T. A. Edison.) Dated February 28.

774. "Electric lamps." J. FYFE. Dated February 23.

783. "Improvements in electrical conductors applicable to electric railways, and to electric signalling and in apparatus connected therewith." J. PERRY and W. E. AYRTON. Dated February 24.

785. "An improved method of covering wire for electrical purposes, and in the orderly arrangement of multiple electrical conductors." W. E. AYRTON. Dated February 24.

792. "Improvements in electric lamps, and in circuits for the same." P. JENSEN. (Communicated by T. A. EDISON.) Dated February 24.

803. "Improvements in dynamic apparatus and motors, in batteries in connection therewith, and in carbons for obtaining electric light." R. WALLER. Dated February 25.

843. "Cards and magnetic needles for mariners' compasses." H. J. HADDAN. (Communicated by J. Lewis and F. A. Brown.) Dated February 28.

844. "Galvanic batteries." F. WIRTH. (Communicated by E. M. Reiniger.) Dated February 28.

859. "Apparatus used in erecting and repairing overhead telegraph wires." J. W. FLETCHER. Dated March 1.

879. "Improvements in electric light signalling, and means or apparatus connected therewith." A. SHIPPEY. Dated March 1.

894. "Electric lamps." J. J. SACHS. Dated March 2.

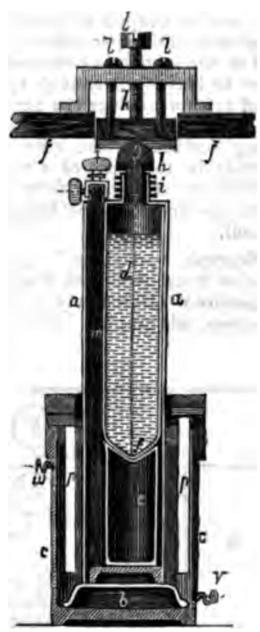
913. "Improvements in machinery for twisting and lapping wires and other materials in the manufacture of ropes or cables; for insulating and covering telegraph wires, and for other analogous purposes." W. T. GLOVER and G. F. JAMES. Dated March 3.

918. "Method and apparatus for producing audible signals on railways by electricity." E. TYER. Dated March 3.

925. "Telephone transmitters." C. MOSELY. Dated March 4.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1880.

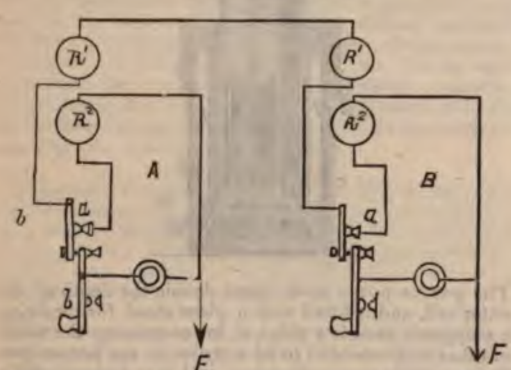
2597. "Electric batteries." A. V. NEWTON. (A communication from abroad by Ferdinand Tommasi, of Paris.) Dated June 25. 6d. Relates to batteries in which two exciting liquids are employed, the chief object being to provide a continuous supply of acid to the porous pots, and also to insure the cutting off of this supply from all the pots of the battery simultaneously. The figure is a vertical section of a single cell battery. *a* is the porous pot, which rests upon a support of earthenware or glass, *b*, contained in a glazed outer cell, *c*.



The porous pot is made about double the depth of the outer cell, and is fitted with a glass stand for receiving a stoppered vessel or phial, *d*, for containing the nitric or other acid intended to be supplied to the porous pot. This vessel is semi-cylindrical, and it is formed with a conical bottom in order to fit a conical recess made in the stand, *e*. The stand, *e*, is of similar shape, but is somewhat smaller in cross section than the vessel, *d*, in order to provide space for the reception of a sufficient quantity of acid to insure the proper action of the battery. At the bottom of the glass vessel, *d*, is a small opening, *f*, for the discharge of the acid, and the vessel is so situate that this opening will be at about the level of the exciting liquid in the outer glazed cell

c. This arrangement provides against the reserve of acid contained in the vessel, *d*, mixing with the partially exhausted acid in the porous pot, and allows of the acid in the porous pot being maintained at any desired level. The glass vessel is fitted at its upper end or neck with a loose glass stopper, *g*, under the flange of which is placed an india-rubber washer, *h*, that will seal the opening and prevent the admission of air to the vessel, *d*. A coiled spring, *i*, surrounding the neck of the vessel and bearing on the under side of the stopper serves to raise the same from its seat and admit air into the vessel, *d*, whereby a discharge of the acid into the porous cell will be effected, the rate of supply being determined by the amount of air admitted. *m* is the carbon contained in the porous pot. To regulate the admission of air to the vessel, *d*, the cells of the battery are arranged in a case, which is provided with a cover, *j*; this cover when closed will overlie the stoppers of all the glass vessels of the battery, and immediately over each stopper a hole is formed in which a loose piece, *k*, is fitted; this loose piece is held in position and can be adjusted relatively to the stoppers by means of the bridge and screws, *l*, *l*, *l*. The cover of the box is hinged, and provided with a regulating screw and winch handle, by which means, through the pressure of the pieces, *k*, on the stoppers, *g*, the quantity of acid supplied to the carbons may be regulated to the greatest nicety or shut off at pleasure. In the latter case the action of the battery will be suspended. The vessel, *d*, and carbon, *m*, are so shaped relatively to each other as to fill the space at the upper end of the porous pot. The lower end of the carbon is however reduced in dimensions, so as to leave just enough space for a sufficient quantity of acid to produce the necessary chemical action in the cell. In order to increase as much as possible the acting surface of the zinc element of the battery, it is made in the form of a series of rods or blades, *p*, *p*, which are suspended from a slotted metal ring, *n*, or it may be from an insulating cover carried by the glazed cell.

2710. "Telegraph apparatus." CARL KESSELER. (A communication from Friedrich Fuchs, of Berlin, in the German Empire.) Dated July 2. 6d. Relates to a system of duplex telegraphy. The mode in which



telegraphing is carried on is as follows:—If the key at station, A, is depressed, the contact screw on the contact lever, *b*, being set properly, the connection between the latter and the contact, *a*, is interrupted at *a*, and the electro-magnet coils of the apparatus separated from each other, that is, the coil, R^2, is thrown out of circuit. But at the moment the key lever touches the contact screw, *c*, the battery is closed, and the current therefrom passes by *b*, through the coil, R^1, into the line wire. At the station, B, where there is still contact at *a*, the current traverses the two coils of the apparatus, and then goes to earth. When the return spring of the armature is properly regulated, the apparatus at A, where the current only passes through one coil, does not speak, whereas the apparatus at B, where the magnetic influence on the armature is about double that of A, responds. If the key at A and that at B are simultaneously depressed, the coil, R^2, is thrown out at both stations; but as now the batteries of both stations (which are connected to earth with their poles opposing) send their current into the line wire, and as moreover the coil, R^1, is traversed by a current of double the speaking strength, and hence, the magnetic influence on the armature is as great as when the current from one battery traversed both coils, it follows, therefore, that the apparatus must respond both at A and B. As soon as the key at one station drops into its normal state of rest, the current in the line wire falls to half its strength, and the armature of the apparatus at the other station falls off.

2730. "Automatic electric time signalling apparatus." JASPER WETTER. (A communication from abroad by William H. Shuey, of United States of America.) Dated July 3. 1s. Relates to improvements in automatic electric time signalling apparatus, the object being to combine with any approved time mechanism an electric signalling apparatus which shall be operated by and in unison with the time mechanism, and shall be of such construction and arrangement of parts that it will actuate one or more signals automatically at any predetermined periods of time throughout the twenty-four hours of each day. The invention consists, first, in the combination with a time piece provided with mechanism for breaking an electric circuit at any regular intervals of time of a motor actuated by spring, weight, water, or other power; a wheel furnished with stop pins corresponding in number to the number of minutes in twenty-four hours, said wheel being revolved by the motor; a circuit closing device connected with the signalling devices and adapted to close the circuit at any moment of time indicated on the wheel, the stop pin corresponding to the time of sounding, the signal being withdrawn to allow of the automatic closing of the circuit; an armature connected at one end with the circuit closers and electric magnets located in the circuit embracing the time mechanism, and adapted to regulate the movement of the stop pin wheel and cause the motor connected therewith to impart an intermittent rotary movement thereto, and move it through a space equal to the distance between any two adjacent stop pins, showing each movement of time as indicated by the time mechanism. It further consists in the combination with a wheel or cylinder provided with any desired number of removable stop pins and mechanism for revolving said wheel in unison with a time piece or regulator of two or more circuit closers located in the electric circuit embracing the signals, said circuit closers being arranged to close the circuit at any moment of time during the twenty-four hours of a day by removing the stop pin designating the minute at which it is desired to sound the signal. The invention also consists of a wheel provided with a continuous row of stop pins extending around the wheel any desired number of times in a spiral form or line, of an automatic circuit closer and mechanism for moving said circuit closer transversely across the periphery of the wheel or cylinder.

2764. "Electric lamps." GEORGE GUILLAUME ANDRÉ. Dated July 6. 8d. The objects of the

vention are to regulate the position of the electrodes so that the resistance of the voltaic arc is practically maintained constant. A small electro motor is used to propel the electrodes. The armature of the motor is wound with a double set of wires, so that the armature ring can be made to revolve in the direction of the predominating current whenever the equilibrium between them is destroyed, and in this way the relative position of the electrodes is varied or changed as may be required in order to restore equilibrium in the coils of the ring.

2849. "Signalling apparatus." FREDERIC NEWTON GISBORNE. Dated July 10. 6d. The object of this invention is to provide a signalling apparatus suitable for transmitting messages by visible signals from a shore station to ships at sea, and from one station to another, where the electric telegraph is inadmissible. Symbols are employed representing the ball, flag, and pennant, and these are used either as solid figures in black on a white ground, or white on a black ground, or as transparencies which when illuminated will be visible at night; or the symbols may be painted solid on a transparent ground, and used to throw shadows on an illuminated surface. The signals are turned in position by hand mechanism.

2865. "Synchronising or setting clocks, &c." JOHN ALEXANDER LUND. Dated July 12. 2d. Relates to synchronising clocks by means of an electric current, or by a pneumatic or other time signal, which is sent every hour from a normal or standard clock. The main object being to allow of the clocks being set or corrected from a greater error than has hitherto been attainable with apparatus of this description. A heart piece is used in connection with a stop piece and levers similar to those used in chronograph watches; the stop piece is caused to revolve by the fall of a weighted lever, which releases the minute spring, sets the hands, momentarily detains the hands at correct time, and resets the minute spring, leaving the clock then to go on until the next successive set. (*Provisional only.*)

2888. "Signalling apparatus for mines." H. J. HADDAN. (A communication from abroad by Charles Cummings, of Virginia City, Nevada, United States of America.) Dated July 13. 6d. Relates to an electric signalling apparatus, consisting of a steam whistle operated by an electro-magnet.

2891. "Detecting and indicating stoppages, &c., in telegraphic or pneumatic communications." JOHN ALEXANDER LUND. Dated July 13. 2d. Relates to means or apparatus for detecting and indicating faults in telegraphic or pneumatic communications whereby a visible or audible indication may be given. On any suitable part of the "motion" or train of the time piece two insulated pins are set. One of these pins acts upon one of the contact springs a few minutes before the passage of the testing current which is transmitted, thus bringing the one spring partly towards contact with the other spring, but leaving it held by a catch. The testing current is made to pass through an electro-magnet, the keeper or armature of which is attached to the catch, and therefore as long as the telegraph line is in working order the catch is withdrawn by the passage of the testing current. The spring is therefore released and the second pin passes it without acting on it. But should the communication be broken either in the line tube or instrument, and the testing current fail to pass through, the spring remains held by the catch, and then the second pin acts upon it and brings it into contact with the second spring, so that the circuit through the local battery being complete, the current from this battery passes to the bell alarum, causing the same to sound, and also to the indicator, which will then indicate that the line is broken down.

2980. "Regulators for electric lamps." A. M. CLARK. (A communication from abroad by John Henry Guest, of Brooklyn, United States of America.) Dated July 20. 2d. The object of this invention is to furnish means for automatically regulating the length of the arc in electric lamps, and to prevent fluctuations in the light by changes in intensity of current. The invention consists primarily in a thermoscopic rod combined with an electric lamp for expansion, according to the intensity of the current and resistance in the circuit. The lineal expansion is multiplied by levers, which act by clamps to separate the carbons. The invention also consists in the combination with the expansion rod of a section of carbon or metal of low conductivity, whereby the heat due to resistance is rapidly generated and dissipated; also in a shunt for dividing the current when the carbons are separated to a definite point, and in certain other details of construction which render the action more perfect and adjustable. (*Provisional only.*)

Reviews.

Des Applications du Téléphone et du Microphone à la Physiologie et à la Clinique. Par Dr. M. BOUDET, de Paris. Vve. Frédéric Henry, Rue de l'Ecole de Médecine, Paris.

ALTHOUGH the microphone combined with the telephone at first seemed likely to prove of considerable value to the medical world, yet the success obtained in this direction can hardly be said to have been great; indeed at the present time but little if anything is heard of the new idea.

Amongst the most prominent workers on the subject has been Dr. Boudet, the author of the above work. In a well written book of nearly two hundred pages Dr. Boudet has dealt very fully with the whole matter. As is pointed out in the preface, a great cause of the failure of the microphone-telephone instrument to produce useful results has been the disagreement among physicians as to the exact nature of the sounds produced by the instrument. Unlike the stethescope, the microphone-telephone does not enable sounds produced in the body to be heard plainly, but it merely copies, as it were, those sounds, and sometimes does so very imperfectly.

Since the discovery of the microphone Dr. Boudet has studied the conditions under which the marvellous sensibility of the apparatus can be utilised, and the results are given in his work. The first part of the book describes the receiving apparatus, the ordinary Bell telephone, pointing out the construction and action of the latter. The transmitters, which are alluded to next, are divided into two classes, viz., those which produce complete interruptions of the current, and those which vary the latter. These descriptions, for the kind of book, are very full, almost unnecessarily so. In the chapters dealing more directly with the general subject of the work, muscular action, the circulation of the blood, affections of the throat and of the heart, &c., are diagnosed by means of the microphone-telephone,

and with good results. Particular forms of the microphone have been designed for these purposes, which are described and illustrated. In conclusion Dr. Boudet states that the microphone-telephone is likely to prove a valuable auxiliary to the faculty.

Questions on Magnetism and Electricity. By F. W. Levander, F.R.A.S. H. K. Lewis, Gower Street, London.

This little book contains solutions of questions in magnetism and electricity set at the preliminary scientific and first B. Sc. examinations of the University of London from 1860 to 1879, together with definitions, dimensions of units, miscellaneous examples, &c. There can be no doubt but that a book of the kind is very useful to students preparing for examinations. Mere questions are not enough, as, of course, the learner has no certain means of verifying the correctness of his answers. In Mr. Levander's work the replies to the various questions are given in a clear and brief manner, just in the way in fact in which the answers should be given at an examination.

Telegraphic Tales and Telegraphic History. By W. J. Johnston, Murray Street, New York.

The main portion of this book is taken up with a collection of stories and anecdotes with which telegraphic history is very rich; but although the reader will find very much to entertain and amuse him, yet he will also find a large amount of interesting information given. The work is certainly worth perusing, and it deserves a good sale.

Books Received.

La Telectroscope. Par M. Senlecq d'Ardres. Paris: 38, Rue de la Sourdière; London: 29, Bedford Street, Strand.

Electro-Typing. By J. W. Urquhart. Crosby Lockwood & Co.

Electricity. By Fleeming Jenkin, F.R.S. Society for Promoting Christian Knowledge, London.

Proceedings of Societies.

PHYSICAL SOCIETY.—February 26th.

Prof. Fuller in the Chair.

The former resolution regarding the moneys of the Society for investment was adopted.

Dr. O. J. Lodge exhibited a hydro-mechanical apparatus illustrating the fact that conductors of electricity are opaque to light, and showed by means of a Wheatstone's photometer (which combines two circular motions into a harmonic one), how the plane of polarisation of a beam of light passing through a magnetic medium is rotated.

Mr. C. V. Boys exhibited his new integrating machine, which is the only one illustrative of the mathematical process of integration, and is therefore specially valuable for teaching purposes.

Mr. Shelford Bidwell read a paper on the telegraphic transmission of pictures of natural objects. The process is explained as follows:—The positive pole of a battery is connected through a set of resistance coils to a piece of platinum wire, and the negative pole to a plate of zinc, upon which is placed a sheet of paper moistened with a solution of potassium iodide. The negative pole of a second battery is connected through a selenium cell with the same platinum wire, and the positive pole to the zinc plate. The point of the platinum wire is pressed upon the paper, and the selenium being exposed to a strong light, the variable resistance is so adjusted that the currents from the two batteries, which pass through the paper in opposite directions, exactly neutralise each other. The platinum point will now make no mark when drawn over the paper; but if the selenium is shaded, its resistance is immediately increased: the current from the first battery then predominates, and the path of the platinum point across the paper is marked by a brown line, due to the liberation of iodine. The line is fainter the feebler the light is. [This arrangement has been applied by Mr. Bidwell in his "tele-photograph," exhibited to the meeting.] The transmitter consists of a brass cylinder, mounted on a screw spindle, which carries the cylinder laterally $\frac{1}{75}$ inch at each revolution. A pinhole in the middle of the cylinder allows light to fall upon a selenium cell placed behind it within the hollow cylinder. The cell is connected in circuit with a battery and the line. The receiver consists of a similar metal cylinder, mounted so as to rotate synchronously with the first, and having a platinum point pressing upon a sheet of chemical paper wrapped round the cylinder. This receiver and transmitter are connected up, as described above, with two batteries and a set of resistance coils. The image to be transmitted is focussed upon the cylinder of the transmitter, and the resistance adjusted, and the receiving cylinder covered with sensitised paper. The two cylinders are caused to rotate synchronously; the pinhole, in the course of its spiral path, covering successively every point of the focussed picture. The amount of light falling upon the selenium will be proportional to the illumination of that particular spot of the projected image which is for the time being occupied by the pinhole, and the intensity of the line traced by the platinum point in the receiver will vary in the same proportion. These variations will produce a picture which, if the instrument were perfect, would be a counterpart of that projected upon the transmitter. Simple designs cut out of tin-foil, and projected by a lantern, have been successfully transmitted. With selenium, and paper of greater sensitiveness, more perfect results might undoubtedly be obtained.*

Professors Ayrton and Perry showed an experiment illustrating their plan for sending light and shade images by electricity. A selenium cell was connected in circuit with a battery and a coil of wire, surrounding a tube, along which a beam of light passed. A shutter, having a small magnet attached, was suspended in the tube like a galvanometer mirror, so that when a current traversed the coils the shutter was deflected, so as to close or partially close the tube and shut off the beam of light. It will be understood that when a ray of light fell on the cell, and diminished its resistance, the current in the coils would increase to a degree proportional to the intensity of the ray, and thus the shutter would

* For illustrated description of this apparatus see page 82 of last issue.

proportionally cut off the light in the receiver. If, now, a number of these elementary circuits were combined, so as to provided a mosaic of cells to transmit the reflected image of an object, and a screen to receive the corresponding beams of light, controlled by the shutters at the other end of the line, there would be a means of sending light and shade images by wire. A rapidly rotating arm, carrying a row of cells upon it, might answer for a stationary mosaic transmitter, and need fewer cells; while a Japanese mirror, having its curvature altered by electro-magnets behind, might be made to act as a receiver; the "magic" images of that mirror being due to inequalities of curvature.

Professor AYRTON agreed with Mr. Bidwell in his conclusion that selenium cells of high resistance were more sensitive to light than cells of low resistance.

Dr. COFFIN suggested that Mr. Bidwell should adopt other than the cylindrical form of receiver, and move an image of the object across the pinhole.

Professor G. C. FOSTER advised bringing the light always on one and the same part of the selenium cell.

THE SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.

AN ordinary general meeting of this Society was held on Thursday, February 24th, Professor CAREY FOSTER, President, in the chair. The minutes of the last general meeting having been read and confirmed, and the list of new and proposed members read, the discussion on Mr. Alexander J. S. Adams' paper on "Earth currents and electric tides" was concluded.

Mr. WILLOUGHBY SMITH gave some further particulars with reference to his experiments on wires laid across the Thames.

Mr. A. J. S. ADAMS, in replying, said that with reference to solar and lunar variation, it was difficult to separate the two influences, as the two were merged together; the same was the case with reference to the connection between the magnetic variation and the earth currents. In comparing the earth current curves it was advisable to make the comparison with solar and lunar variation rather than with the time of high water. He pointed out that some curves, plotted out from observations taken in Persia, agreed with his theory. Some experiments made by Mr. Graves at Valentia, on a piece of cable 560 miles long, showed similar results; and as, in this case, but a very small portion was subjected to tidal influence, this was a proof against the theory that the currents were due to the flow of tidal water. The curves obtained at Valentia showed a lagging of one hour behind the moon's changes, which agreed with his own observations. Some experiments, made in 1868, on one of the Irish cables, showed that currents existed which followed the rise and fall of the tide, and varied with the beat of the waves. The currents from the flow of a river under wires, he considered, would be too weak to be appreciable. He thought that currents could not be due to differences of potential at different parts of the earth's surface, as the longer the line the stronger ought to be the current, which was not the case.

Lieutenant CARDEW, R.E., said that he had observed powerful earth currents on a bare wire, fifteen miles long, laid on the ground; this occurred as a storm passed over it.

A paper was then read by Lieutenant CARDEW, R.E., on "The application of dynamo-electric machines to railway rolling-stock." It was proposed to attach a dynamo machine to the axle of the driving-wheel of the locomotive of the train, and to pass the current generated through dynamo machines connected to the wheels of the carriages, these wheels would then be rotated by the current, and would give a more uniform motion than would be the case when the engine alone drew the train. By changing the connections, the current could be made to retard the motion of the wheels of the carriages, as thus to act as a brake.

Mr. ALEXANDER SIEMENS, Mr. C. E. SPAGNOLETTI, and Mr. G. K. WINTER doubted the practicability of the scheme.

Mr. R. E. CROMPTON thought the difficulties in adapting the scheme were by no means so great as the latter gentlemen seemed to think. He thought it a remarkable thing that no decided attempt had been made to design a dynamo machine brake by attaching a dynamo to the axles of the carriages, and then simply closing the circuit of the machine when a brake action was required. The way in which the short-circuiting of a dynamo machine "drew up" the driving-engine was remarkable.

Mr. KEMPE pointed out that with a dynamo-electric-brake the action would become less and less as the train was drawn up.

Professor AYRTON said that this would be a positive advantage, as the experiments of Col. Galton, for the Board of Trade, had shown.

Mr. EDWARD B. BRIGHT then read a paper on "The interference with the processes of manufacture of wool and hair, arising from the development of electricity during spinning." It was found in spinning factories that the fibres of the material used had a tendency to cling to parts of the machine when the process of spinning was being carried on, so much was this the case that in some climates it was found impossible to work except at certain seasons of the year. To get rid of this effect it was the custom to place the wooden bobbins full of the half manufactured material in a damp cellar, and to keep them there for a considerable period before remanufacture. The cause of the clinging action was found to be due to electricity, and it was at first thought that putting the machinery to earth would get over the difficulty, but this only tended to aggravate it. Finally it occurred to the author that electricity could discharge itself readily in a partial vacuum. Accordingly the bobbins were placed in an iron chamber partially exhausted of air; this device was completely successful, and bobbins which formerly required several months to discharge could be discharged in as many minutes.

Mr. PREECE said that the peculiar effect had first been assigned to electrical action by Mr. Gilpin, the clerk of Mr. Bright; the latter gentleman had discovered the method of getting rid of the electricity by a device which answered very perfectly.

After some remarks by the President the meeting adjourned, votes of thanks having been proposed and carried.

City Notes.

Old Broad Street, March 11, 1881.

DIRECT UNITED STATES CABLE COMPANY, LIMITED.—The seventh ordinary general meeting of the above Company was held on February 25th at the City Terminus Hotel, under the presidency of Mr. J. Pender, M.P. The chairman, in moving the adoption of the report (see TELEGRAPHIC JOURNAL, last issue), referred to the completion of the arrangements respecting the agreement between the Anglo-American, the

Direct United States Cable Company, and the French Company. Alluding to the report, he went through the figures given relating to the working of the half-year, which he said had been of a very satisfactory nature. The reduction in the revenue was attributable to the low competitive tariffs which had been in force for a portion of the half-year. It was hoped that the reduction of the tariff from 3s. to 2s. a word would be appreciated by the telegraphing public, and result in benefit to the Company. He had intended to go somewhat into details as to the condition and prospects of Atlantic telegraphy generally, but circumstances had arisen which for the present had given rise to litigation, and it would be injudicious for him to say anything which could prejudice the case one way or the other. They were narrowly watching the interests of the proprietors, and they looked forward hopefully to the future. Mr. W. Ford seconded the motion, which was at once unanimously adopted, and a vote of thanks to the chairman and directors closed the proceedings.

TELEGRAPH CONSTRUCTION AND MAINTENANCE COMPANY.—The annual meeting of this Company was held on the 1st inst. at the Cannon Street Hotel. The chairman, Sir Daniel Gooch, Bart., M.P., in moving the adoption of the report (given in our previous issue), stated that during 1880 the Company's operations comprised the completion of the Eastern Extension Telegraph's duplicate Australian cable, and the laying of cables connecting the Northern and Middle Islands of New Zealand; between the Island of Luzon (Manilla) and Hong Kong; and connecting Newbiggin, on the east coast of England, with Arendal, in Norway, and Arendal with Marstand, on the coast of Sweden. The total length of cables laid during the year was 3,453 miles. The shareholders must feel satisfied at the completion before the commencement of 1880 of the Cape cable, and at the important part which the Company had taken in the work. They and the Eastern Company were the only parties who originally found money to lay the cable; and it was with great difficulty that they had obtained help from the Government. The Government ought to congratulate themselves and the Company upon having had the use of that cable during the last twelve months, and more particularly during the last few days. The news which had been recently communicated from the Cape had undoubtedly been very sad, but it had come in a way which must be very useful to the Government departments. The Company had chartered one of their ships—the *Calabria*—to carry troops to the Cape. She sailed from Kingstown on Sunday last, and her fittings and equipment were entirely to the satisfaction of the Government superintendents. In reply to Mr. W. Abbott, the chairman stated that the Company would do all they could to secure orders for laying cables for electric lighting. He had seen those at present in use. They were of a very rough character, being simply wire covered with tarred hemp, and there was great room for improvement. Sir Daniel Gooch then moved the adoption of the report and the declaration of the dividend. Sir George Elliot, Bart., seconded the motion, which was carried.

MONTEVIDEAN AND BRAZILIAN TELEGRAPH COMPANY, LIMITED.—The annual general meeting of the shareholders in this Company was held on March 10th at the offices, King's Arm's-yard, Moorgate-street, under the presidency of Sir T. G. Browne. The report stated that the Company's percentage of the gross earnings of the Western and Brazilian Company amounted, for the year ending the 31st of December last, to £3,256, the December quarter being estimated at £850. After setting aside £500 for redemption of debentures and providing for all charges and debenture interest accruing during the year, there remained a net balance of £1,491, out of which it was proposed to pay a dividend of 3s. per share, being £1 10s. per cent., and to carry forward £244 to the next account. The balance-sheet showed that £2,250 of the debentures had been redeemed, leaving £13,830 still outstanding. The chairman formally moved the adoption of the report: and the motion, having been seconded by Lieut.-Col. G. W. Macauley, it was carried unanimously. The dividend was next declared on the motion of the chairman, seconded by Mr. C. Cameron, M.P.; and the retiring directors, Sir T. G. Browne, and the auditor, Mr. W. S. Ogle, having been re-elected, the meeting terminated.

THE Brazilian Submarine Telegraph Company, Limited, have declared an interim dividend of 3s. 6d. per share, free of income-tax.

THE India Rubber, Gutta Percha, and Telegraph Works Company, Limited, notify that with reference to the Mexican Telegraph Company's cable, a further telegram has been received announcing the completion of the section from Tampico to Vera Cruz, thus placing the latter in connection with the American land lines.

THE estimated traffic receipts of the Anglo-American Telegraph Company for the month of January are £48,550, against £67,980 for January, 1880; and for the month of February are £49,180, against £40,830 for February, 1880. Those of the Direct United States Cable Company for January last are £16,180, and for February £16,390. It must be borne in mind that the tariff of the Anglo Company last year at this time was 3s., whereas it is now but 2s. per word.

The following are the final quotations of telegraphs:—Anglo-American, Limited, 58-58½; Ditto, Preferred, 86-86½; Ditto, Deferred, 30-30½; Black Sea, Limited, ——; Brazilian Submarine, Limited, 10-10¼; Cuba, Limited, 8¾-9¼; Cuba, Limited, 10 per cent. Preference, 16¼-16¾; Direct Spanish, Limited, 3½-4; Direct Spanish, 10 per cent. Preference, 13-13½; Direct United States Cable, Limited, 1877, 10¾-11; Scrip of Debentures, 101-103; Eastern, Limited, 9½-9¾; Eastern 6 per cent. Preference, 12½-12¾; Eastern, 6 per cent. Debentures, repayable October, 1883, 104-107; Eastern 5 per cent. Debentures, repayable August, 1887, 101-103; Eastern, 5 per cent., repayable Aug., 1899, 102-105; Eastern Extension, Australasian and China, Limited, 9⅞-10⅛; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 108-111; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 104-106; Ditto, registered, repayable 1900, 104-106; Ditto, 5 per cent. Debenture, 1890, 102-104; Eastern and South African, Limited, 5 per cent. Mortgage Debentures, redeemable 1900, 101-103; Ditto, ditto, to bearer, 102-104; German Union Telegraph and Trust, 10-10½; Globe Telegraph and Trust, Limited, 6⅛-6⅜; Globe, 6 per cent. Preference, 12-12¼; Great Northern, 11⅛-11⅜; 5 per cent. Debentures, 102-105; Indo-European, Limited, 26-27; London Platino-Brazilian, Limited, 5⅞-6⅛; Mediterranean Extension, Limited, 2½-3; Mediterranean Extension, 8 per cent. Preference, 10-10½; Reuter's Limited, 10¾-11¼; Submarine, 270-290; Submarine Scrip, 2⅝-2⅞; Submarine Cables Trust, 99-102; United Telephone Company, ——; West Coast of America, Limited, 4⅜-4⅝; West India and Panama, Limited, 1½-1¾; Ditto, 6 per cent. First Preference, 6¼-6¾; Ditto, ditto, Second Preference, 5¼-5¾; Western and Brazilian, Limited, 7⅛-7⅜; Ditto, 6 per cent. Debentures "A," 103-107; Ditto, ditto, ditto, "B," 98-102; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 122-127; Ditto, 6 per cent. Sterling Bonds, 101-104; Telegraph Construction and Maintenance, Limited, 35½-36; Ditto, 6 per cent. Bonds, 105-108; Ditto, Second Bonus Trust Certificates, 3½-3¾; India Rubber Company, 18½-19; Ditto, 6 per cent. Debenture, 103-106.

THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. IX.—No. 196.

THE two following important Papers have recently been read before the Royal Society. We publish them *in extenso* and, through the kindness of the authors, have been enabled to give full illustrations of the apparatus employed in carrying out the experiments, in addition to those given with the papers.

ON THE CONVERSION OF RADIANT ENERGY INTO SONOROUS VIBRATIONS.

By WILLIAM HENRY PREECE.

(Read before the Royal Society, March 10, 1881.)

MESSRS. GRAHAM BELL AND SUMNER TAINTER* have shown that, under certain conditions, intense rays of light, if allowed to fall with periodic intermittence upon thin discs of almost every hard substance, will set up disturbances in these discs, corresponding to this periodicity, which result in sonorous vibrations. Mr. Bell† has subsequently shown that such effects are not confined to hard substances, but that they can be produced by matter in a liquid or gaseous form.

These discoveries have elicited a considerable amount of interest, and have led to the inquiry whether the sonorous effects are due, as the discoverers themselves surmised, to *light*, or as the President of the Royal Society, Professor Tyndall, and others have suggested, to radiant *heat*.

Messrs. Bell and Tainter have partially answered this question by showing that the disturbances are not necessarily due to light, for they found that sheets of hard rubber or *ebonite*—a substance opaque to light—do not entirely cut off the sounds, but allow certain rays to pass through, which continue the effect. M. Mercadier, who has studied the subject with great care,‡ has shown that the effects are confined to the red and ultra-red rays. Moreover, Mr. Bell has shown that gases, such as sulphuric ether, which Professor Tyndall has proved to be highly absorbent of heat rays, while they are transparent to light rays, are remarkably sensitive to this intermittent action. Dr. Tyndall has more recently read a paper before the Society§ proving that these sonorous effects are a function of all gases and vapours absorbing radiant heat, and that the intensity of the sounds produced is a measure of this absorption.

The negative proof of Messrs. Bell and Tainter can be rendered positive if it can be shown that ebonite is *diathermanous*. The author provided himself with several sheets of different substances, and a sensitive radiometer. A standard candle and a lime-light were used as sources of energy, the former being fixed four inches and the latter four feet from the radiometer, which was carefully screened from all disturbing influences but that of the source. The number of revolutions made by the radiometer per minute was counted, and the average of several observations was taken. The following is the result, and the numbers indicate the relative diathermancy of the substances used to the source of light employed :—

1. Experiments on Diathermancy.

Material.	Source of radiant energy.	
	Candle, 4 ins.	Lime-light 4 ft.
Air	100	100
Ebonite, No. 1 (·4 millim.)...	60	91
,, ,, 2 (·9 millim.)...	24·3	79·3
,, ,, 3 ,, ...	24·3	79·3
,, ,, 4 ,, ...	24·3	68·2
,, ,, 5 ,, ...	24·3	68·2
,, ,, 6 (·4 millim.)...	0	9
India-rubber (native)	44·3	61·4
,, (prepared)	60	54·5
,, (vulcanised) ...	0	0
,, (and ozokerit)..	0	6·8
Ozokerit (·5 millim.)	0·14	9
Carbon (2 millims.)	0	
Carbonised paper................	0	
Blue foolscap......................	0	4·5
White note paper................	0	4·5
Thin foreign	0	
Tissue.................................	0·6	

Ebonite was, however, proved to be very variable, and while some pieces proved to be as diathermanous as rocksalt, others of the same thickness were found to be quite athermanous.

Ebonite therefore, being sometimes diathermanous and opaque, it is clear that the sonorous vibrations of Bell and Tainter are the result of disturbances produced by some thermic action rather than by any luminous effect. Several other experiments made by them confirm this conclusion, notably those made upon crystals of sulphate of copper, a substance which Mr. Crookes has shown to be highly opaque to rays of low refrangibility.*

Now, the questions arise, is this thermic action, expansion and contraction of the mass due to its absorption of heat? Or is it a disturbance due to molecular pressure similar to that which produces the rotation of the radiometer? Or is it due to some other cause?

The argument against the first assumption when applied to hard discs, is that *time* is a material element in such actions, and that the rate of cooling of warmed diaphragms is too slow to admit of such effects. Lord Rayleigh† has questioned the validity of this argument, and has shown that if the radiating power of the body experimented on were sufficiently high a slow rate of cooling would be favourable to rapid fluctuations of temperature. It became desirable to test this point experimentally. The following apparatus was constructed for the purpose.

AB, fig. 1, is a thin strip or wire 6 centims. in length of the substance to be examined, fixed to a platinum "make and break," M, and adjusted to a lever, S, round whose axis is fastened a silk thread, the end of which is attached to the strip or wire at A, and whose position could be adjusted by a screw, C. Any variation of

* American Association for the Advancement of Science. Boston, August 27, 1880.
† *Journal of the Society of Telegraph Engineers*, December 8, 1880.
‡ *Comptes Rendus*, December 6, 1880.
§ *Proc. Roy. Soc.*, vol. xxxi., p. 307.

* *Phil. Trans.*, vol. clxix., § 268.
† *Nature*, January 20, 1881.

tension due to expansion or contraction of the wire would produce intermission in the electric currents passing through the telephone, T, which, if periodically produced, would result in sonorous vibrations in the telephone. Heat from various sources and at various distances, from bright lime-light to dull heat from hot metallic surfaces, was allowed to fall through rotating vanes intermittently on AB; but notwithstanding every precaution, and the many materials used, not more than six interruptions per second could be produced, although the system was beautifully sensitive to the smallest changes of temperature.

The best effect was obtained when AB was a thin ebonite wire about ·5 millim. in diameter, and 6 centims. in length.

It was evident from these experiments that the sonorous effects of hard discs could not be explained by the change of volume due to the impact of heat rays, and their absorption by the mass of the disc.*

Is the action then due to molecular pressure similar to that which produces the rotation of the radiometer?

It is quite true that the radiometer effect is one visible only in very high exhaustions, but Mr. Crookes (*Phil. Trans.*, vol. clxix., § 220) detected "the existence of molecular pressure when radiation falls on a black surface in air of normal density."

Whenever radiant energy falls on an absorbent surface in air, such as a disc of blackened wood, its wave-length is degraded or lowered, and it is converted into thermometric heat. The molecules of air striking this warmed surface acquire heat, and move away from it with increased velocity, and as action and reaction are always alike in moving away, they give the body a "kick." Since there is no such action on the other side of the disc, there is a difference of pressure between the two sides, which gives it a tendency to move away from the source of energy. The effect is very much smaller in air at ordinary pressures than in air at a very low vacuum, because in the former case, the mean free path of the molecules is very small, and the rebounding molecules help to keep back the more slowly approaching molecules. Nevertheless, molecular pressure is experienced, and if of sufficient magnitude and rapidity it ought to produce sonorous vibrations. It seemed probable that the element of time does not enter here so prominently as in the previous case, for the radiometer effect is a mere surface action of the disc, and not one effecting its mass. Hence it was hoped that the retarding effects would be eliminated. If the sonorous action, therefore, be due to a radiometer action, a difference of effect would be observed if the side of a disc *exposed* to the source of energy, be either blackened by lamp-black or camphor carbon, or if it be polished or whitened.

* This conclusion was confirmed by subsequent experiments, notably by Experiments 7 and 41.

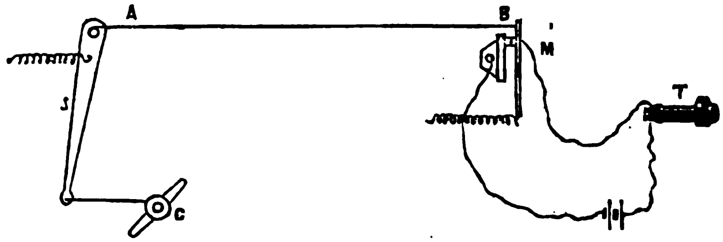


FIG. 1.

An apparatus (fig. 2) was constructed similar in principle to that described by Messrs. Bell and Tainter. The source of light, L, was an oxy-hydrogen lime-light.

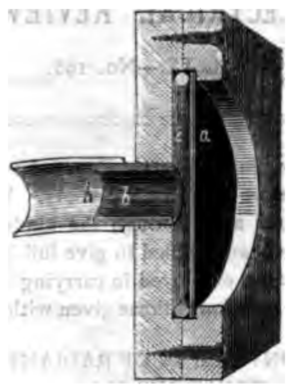


FIG. 3.

The rotating disc, R, was of zinc perforated with holes, which could be noiselessly rotated, so as to obtain 1,000 intermissions per second. A glass lense G, was employed to focus the light upon the perforations of the rotating disc, and another, G′, to render the rays parallel on the other side of the disc. A mahogany case or cup, C, to retain the discs to be experimented upon was constructed as shown in section in fig. 3, and fixed 400 centims. from the source, L; *a*, being the disc 5 centims. in diameter, clamped on by screws; *b*, a brass tube, to which the india-rubber hearing tube, *h*, was fixed; *c*, a circular air space behind the disc, 6 centims. in diameter, and 3 millims. to 5 millims. deep. Cavities of various dimensions and forms, spherical, conical, and trumpet-shaped, were tried, but the ones described were those which gave the best effects.

Experiment 2.—An ebonite disc well blackened on one side when exposed to the intermittent rays was found to produce sounds, which Professor Hughes estimated to be about 20 as compared by his sonometer scale.*

3.† A similar ebonite disc equally well whitened, gave slightly less intense sounds, estimated at 18.

* Professor Hughes' sonometer (*Proc. Roy. Soc.*, vol. xxix., p. 56) proves an excellent apparatus to estimate the relative intensity of low sounds, for by shifting the induction coil from one side to the other, we can pass from an absolute zero, or pure silence, to a limit of sound of considerable intensity. The scale divides this space passed over into 100 equal parts, any number of which give a fairly approximate value of the sounds compared. The ear has to determine the equality of the intensity of the two sounds, *i. e.*, of the sonometer and the source investigated, and the value of the latter is given in terms of the scale of the former.

† The consecutive figures indicate the number of the experiments.

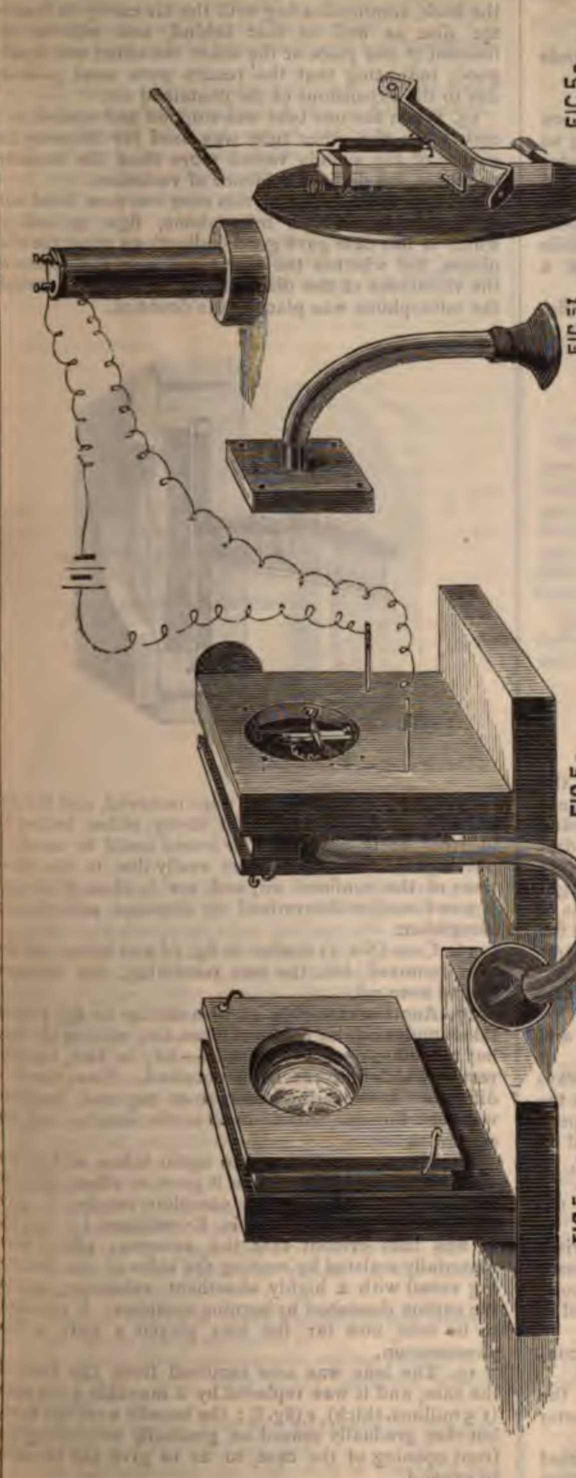


FIG. 5. FIG. 5a. FIG. 5b. FIG. 5c.

FIG. 2.

FIG. 5.—Front of receiver with lens inserted. FIG. 5a.—Rear of receiver with back piece, FIG. 5b, removed to exhibit microphone attached to disc. See also FIG. 5c for enlarged drawing of microphone attached to disc.

4. A zinc disc blackened gave sounds = 8.
5. A similar disc polished gave only sounds = 2.
6. A mica disc blackened gave scarcely any sounds at all.
7. A clean mica disc gave sounds = 5.

These effects were produced many times, and on different occasions, and they were so unsatisfactory as to throw doubts on the accuracy of the radiometer explanation. They were not so decided as theory led one to anticipate. The effects produced by the zinc disc, though very weak, favoured the theory; those given by the mica disc completely refuted it; while those given by the ebonite discs were almost of a neutral character.

It was, however, thought that if D be the disc (fig. 4), and C the source of light, then if the excursions of

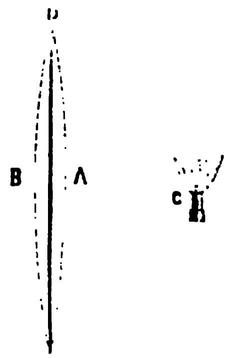


FIG. 4.

the discs to and fro were due to expansion from the absorption of heat, it would first bulge towards A, since the side towards the source of light would expand first. If, on the other hand, it were due to the radiometer effect, it would first bulge towards B.

8. An extremely delicate electrical contact arrangement was constructed to determine this by means of a telephone, which recorded the excursions to and fro of the disc; but the result was sometimes in one direction and sometimes in the other. Moreover, the effect was slow, and we failed to obtain more that five distinct vibrations per second.

This result raised the question whether in Bell and Tainter's experiments *the discs vibrated at all.*

9. A delicate microphone was fixed in various ways on the case, fig. 3. Although the sounds emitted in the hearing tube were as intense as indicated in Experiment 1, scarcely any perceptible effect was detected on the microphone. Had the disc sensibly vibrated, its vibrations must have been taken up by the case. A microphone never fails to take up and magnify the minutest mechanical disturbances.

It was thus evident that the disc did not play a prime part in this phenomenon, but it appeared as Professor Hughes suggested, that the result might be due wholly to an expansion and contraction of the air contained in the air space, *c* (fig. 3).

An entirely new set of cases and discs were now constructed, but of the same dimensions as the first set.

10. With a new clean case and an ebonite disc, the sonorous effects were feeble, viz., 15 on the sonometer scale.

11. If, however, a lens, *d*, were placed close in front of the ebonite disc, *a* (fig. 5*d*), the sonorous effects were magnified considerably, rising at once to about 40.

12. A case was constructed similar to that shown in 5*d*, but with a tube at the side, as well as one at the back, communicating with the air cavity in front of the disc as well as that behind, and whether one listened at one place or the other the effect was equally good, indicating that the results were most probably due to the expansions of the contained air.

13. When the one tube was stopped and opened by a cork while the other tube was used for listening, the quality of the sounds varied more than the intensity, but there was distinct evidence of variation.

14. The ebonite disc of this case was now fitted with an extremely delicate microphone, figs. 5*a* and 5*c*, which in this case gave good indications upon the telephone, but whether the vibrations were the results of the vibrations of the disc itself, or of the air in which the microphone was placed, was doubtful.

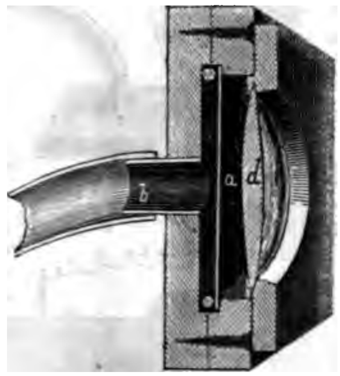


FIG. 5*d*.

15. If the lens, *d* (fig. 5*d*), were removed, and the disc left supported without any air cavity, either behind or in front of it, *no perceptible sound could be obtained*, proving that the effects were really due to the vibrations of the confined air, and *not to those of the disc.* It was therefore determined to dispense with the disc altogether.

16. Case (No. 1) similar to fig. 5*d* was taken, and the disc removed, but the lens remaining, the sonorous effects were *nil.*

17. Another case (No. 2), also similar to fig. 5*d*, was taken under similar circumstances, *i.e.*, *without the disc*, but the effects were very loud—60; in fact, the best results which had yet been obtained. Now, the only difference between the one case or cup and the other was that the one *was blacked in the interior* and the other was not.

18. Hence case No. 1 was again taken without the disc, and though when clean it gave no effect, when its interior was blacked by camphor smoke it gave sounds as strong as those in Experiment 17, viz., 60. It was thus evident that the sonorous effects were materially assisted by coating the sides of the containing vessel with a highly absorbent substance, such as the carbon deposited by burning camphor. It remained to be seen how far the lens played a part in this phenomenon.

19. The lens was now removed from the front of the case, and it was replaced by a movable glass plate (1·5 millims. thick), *e* (fig. 6); the sounds were the same, but they gradually ceased on gradually uncovering the front opening of the case, so as to give the air room to expand.

20. The glass plate, *e*, was replaced by a heavy rigid plate of rock salt, 13 millims. thick, and the sounds were equally loud, namely, = 60.

21. The plate, *c*, was replaced by white note paper. The sounds were very faint but perceptible.

22. It was replaced by thin cardboard, and the effect was *nil*.

23. All these effects were produced equally well, whether the cases were placed at C (fig. 2), 400 centims. from the source of light, or 16 centims. from the rotating disc, R, but in the latter case their intensity was of course always increased.

Hence it is abundantly evident that these sonorous vibrations are due to the motions of the contained air, and not to those of the disc; that they are actually improved by the removal of the disc, that their production is materially assisted by lining the surface of

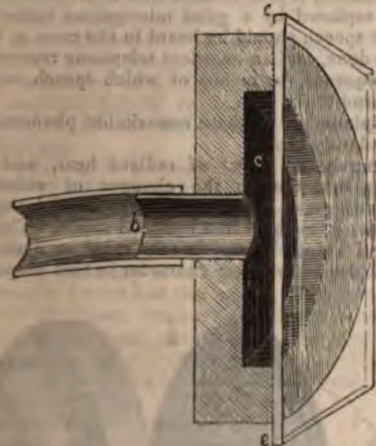


FIG. 6.

the containing space with an absorbent substance, that they are dependent on the heat rays that pass through, and that they disappear when the rays are cut off from the air cavity by an athermanous diaphragm.

24. Dr. Tyndall having shown in the paper already referred to, that water vapour responded actively to these intermittent actions, a clean empty one-ounce glass flask was taken and exposed to the intermittent beams. No sound was produced.

25. It was then filled with water vapour by pouring a small quantity of water into it, and warming it in a flame; fair sounds of an intensity 25 were the result.

26. The flask was filled with the dense smoke from burning camphor, and the sounds were intensified considerably.

27. The case (fig. 6) was taken and a glass plate 1·5 millims. thick fixed in front of it as before.

a. When the glass was dry, sounds were 20.

b. When the glass was wetted on the inside, sounds were 25.

28. Another clear one-ounce glass flask was taken.

a. When clear, sounds = 0.

b. When filled with tobacco smoke, sounds = 5.

c. When filled with heavy camphor smoke, sounds = 30.

29. One side of the flask was blackened on the outside, the other side remaining clear.

a. On exposing the clear side to the light, fair sounds, 25, were obtained.

b. On exposing the blackened side, *no sounds were produced*.

30. The flask was blackened *in the interior* on one side only.

a. When the blackened side was near the source, sounds = 25.

b. When it was away from the source, sounds = 30.

c. When the flask was cleaned, all sounds disappeared.

31. A thin glass plate was now blackened on one side and placed in front of the case, fig. 6.

a. When the black surface was outside, *no sounds were obtained*.

b. When the black surface was inside, good sounds, 30, were the result.

c. When the glass was cleaned, the sounds became = 50.

32. An ebonite plate was similarly treated.

a. When the blackened surface was outside, sounds = 15 were obtained.

b. When the blackened surface was inside, the sounds were = 3.

This being an anomalous result, several experiments were now made to test the behaviour of opaque and transparent bodies, when used as discs, for while in the previous experiments the effect was greatest when the blackened surface faced the interior, here we find the opposite result produced, viz., the greatest effect was produced when the blackened surface was on the exterior.

33. Another ebonite disc 0·6 millim. thick was made dull on both sides by rubbing it with emery paper. It was fixed in case (No. 2), fig. 5*d*, without the lens.

a. It gave sounds = 15.

b. It was now blacked on one side, and when that side was turned to the source, it gave sounds = 30.

c. The unblackened side was turned to the source, and it gave sounds = 15.

34. A thin glass plate (1·5 millims. thick)—

a. When clear, gave sounds = 50.

b. When blackened *thinly* on one side, and that side turned to the source, it gave sounds = 20.

c. When blackened thickly on one side and thinly on the other—

1. Thick side to light, sounds = 0.
2. Thin side to light, sounds = 20.

35. A glass plate (3 millims. thick) was blackened on one side.

a. Black outside, sounds = 2.

b. „ inside „ = 30.

36. A clean mica plate (1·2 millims. thick)—

a. Gave sounds = 30.

b. When blacked on one side.

1. Black outside, sounds = 10.
2. „ inside „ = 30.

37. Thin copper foil blacked on either side, sounds were *nil*.

38. A copper disc (0·2 millim. thick) blackened on one side.

a. Black outside, sounds = 3.

b. „ inside „ = 0.

39. Zinc foil blacked on one side.

a. Black outside, sounds = 10.

b. „ inside „ = 3.

40. Zinc disc (0·7 millim. thick) blackened on one side.

a. Black outside, sounds = 10.

b. „ inside „ = 3.

It thus appears that transparent bodies behave in an opposite way to opaque bodies. Glass and mica can be rendered athermanous and silent by making the carbon deposit sufficiently thick. Zinc, copper, and ebonite can produce sonorous effects by a proper dis-

position of carbon. The effect in these latter cases may be due either to molecular pressure, in fact, to a radiometer effect, though very feeble in intensity; or it may be the result of conduction through the mass of the diaphragm, that is, radiant heat is reduced to thermometric heat by absorption by the carbon deposit on the *outside* of the disc, this heat is transmitted through the disc and radiated to the absorbent gases in the interior.

41. To test these questions, a delicate microphone was fixed on a zinc disc (0·7 millim. thick) without any air cavity in front of or behind it.

a. The disc was blackened; no measurable trace of sound was perceptible.

b. The disc was cleaned, with precisely the same result.

42. The zinc disc was now replaced on the case, fig. 5*d*, with the air cavity, and sounds = 10 were emitted as before.

a. The zinc was neatly covered with white paper —a highly athermanous substance; the sounds were *nil*.

b. The paper was blackened; the sounds were still *nil*.

c. The zinc was covered with clear mica; faint but unmeasurable sounds were heard.

d. The mica was blackened; no perceptible sounds were obtained.

e. The zinc disc was blackened slightly in the usual way; sounds = 10 were obtained.

f. The zinc was *thickly* blackened; all sounds disappeared.

43. Ebonite discs of different thicknesses were used, and layers of carbon of different thicknesses were deposited on the thinnest of them. The sounds became fainter and fainter as the thickness of the layer of carbon and the thickness of the ebonite increased, until they disappeared altogether.

These experiments fully establish the inference that the effect is one of conduction, and that the blackened surface of an opaque body like zinc acts as though the source of heat were transferred to the outside surface of the disc.

44. Tubes of various sizes and dimensions were now tried, to confirm Messrs. Bell and Tainter's observations on tubes. They invariably gave out satisfactory sounds when the intermittent rays were directed into the interior of the tubes, which were always considerably intensified by blackening their interiors, and closing the open end with a glass plate.

45. Since the sounds varied considerably in intensity, according to the number of intermittences per second transmitted, white and ruby glass plates were used, and it was found that the maximum effect (60) was produced when the note corresponding to the intermittences was—

With white glass...... $d' = 297$ vibrations per sec.
With ruby „ ...... $b = 247$ „ „

This showed that the element of time was a function of the amount of radiant energy transmitted through the plate.

46. The two cases, which possessed air cavities of different dimensions, were tried with white glass:

Case 1 gave $b = 247$ vibrations per second.
Case 2 „ $d' = 297$ „ „

Hence it is evident that there is a time element, and that the loudness of the note emitted depends upon the rapidity with which the contained air not only absorbs the degraded energy, but upon the rapidity with which it gives up its heat to the sides of the case and the exits open to it. Though the pitch of the maximum note varied with the cavity and the amount of radiant heat transmitted, its quality never varied, notwithstanding the great diversity of materials used as diaphragms.

47. Since these sonorous effects are due to the expansions of absorbent gases under the influence of heat, and since wires are heated by the transference of electric currents through them, it seemed possible that if we inclosed a spiral of fine platinum wire, P (fig. 7), in a dark cavity, *a*, *b*, *c*, *d*, well blacked on the inside, and sent through it, by means of the wheel-break, W, rapid intermittent currents of electricity from the battery, B, heat would be radiated, the air would expand, and sounds would result. This was done, and the sounds produced were excellent. In fact, with four bichromate cells, sounds more intense than any previously observed were obtained.

Furthermore, it was evident that if the wheel-break, W, were replaced by a good microphone transmitter, articulate speech should be heard in the case, *a*, *b*, *c*, *d*. This was done, and an excellent telephone receiver was the consequence, by means of which speech was perfectly reproduced.

The explanation of these remarkable phenomena is now abundantly clear.

It is purely an effect of radiant heat, and it is essentially one due to the changes of volume in vapours and gases produced by the degradation and absorption of this heat in a confined space. The discs in Bell and Tainter's experiments must be diathermanous, and the better their character in this respect the

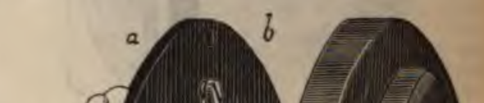


FIG. 7.

greater the effect; remove them, and the effect is greater still. Messrs. Bell and Tainter* showed that the sounds maintained their *timbre* and pitch notwithstanding variation in the substance of the disc, and M.

* *Journal of Society of Telegraph Engineers*, December 8, 1880.

Mercadier found that a split or cracked plate acted as well as when it was whole. These facts are consistent with the expansion of the contained air, but not with any mechanical disturbance of the discs. Moreover, M. Mercadier showed that the effect was improved by lamp-black, but he applied it in the wrong place.

The discs may, and perhaps do under certain conditions, vibrate, but this vibration is feeble and quite a secondary action. The sides of the containing vessel must possess the power to reduce the incident rays to thermometric heat, and impart it to the vapour they confine, and the more their power in this respect, as when blackened by carbon, the greater the effect. The back of the disc may alone act in this respect. Cigars, chips of wood, smoke, or any absorbent surfaces placed inside a closed transparent vessel will, by first absorbing and then radiating heat rays to the confined gas, emit sonorous vibrations.

The heat is dissipated in the energy of sonorous vibrations. In all cases, time enters as an element, and the maximum effect depends on the diathermancy of the exposed side of the cavity, on its dimensions and surfaces, and on the absorbent character of the contained gas.

The remarkable property which deposited carbon possesses of reducing radiant energy to thermometric heat is strikingly shown by these experiments, and it suggests an important field for inquiry for those who are working in the region of radiant heat.

It is only necessary to add that, in carrying out these experiments, I have had the benefit of the presence and advice of Professor Hughes, and the inestimable advantage of the great mechanical skill, philosophical character, and experimental ability of Mr. Stroh, without whom, in fact, the inquiry could not have been accomplished.

Additional Note. Received March 14, 1881.

Professor Stokes has suggested that the action is due, not to the expansion of the contained vapour through its absorption of thermometric heat generated on the lamp-black surface, but to the *contact* of the air molecules with this surface. It is clear that when the carbon is warmed, the rapidly moving air molecules which strike it and bound off have their retreating motion increased in velocity. This increased velocity means increased pressure, which in its turn produces increased volume, and this, when intermittent, produces sonorous vibrations. This explanation is quite in accordance with the observed facts, for the difference of the intensity of the sounds emitted by dry air and air charged with absorbent vapours is very much less when a lamp-black surface is used than was anticipated. Dry air gives excellent results with lamp-black, but is silent without it. Indeed it leads one to conceive that as charging the air with heavy smoke produces the same effect as coating the containing surface with lamp-black, each particle of smoke becomes a warmed surface from which the colliding air molecules, whose dimensions are infinitely smaller, retreat with increased velocity. Moreover, if we conceive the smoke particles replaced by the compound molecules of absorbent vapours, such as sulphuric ether, olefiant gas, or ammonia, and if we assume the dimensions of these molecules greater than those of the air, we have an explanation not only of the absorbent power of these gases, but of the reasons for their behaviour in converting radiant energy into sonorous vibrations. It is clear that if the compound molecule act as a smoke particle, the radiant energy becomes degraded into thermometric heat, for the motion of the ether is transferred to the motion of the molecule. The minute air molecules move unaffected in the undulating ether, but the larger compound molecules of the absorbent gas take up the waves of the ether, and assume that form of motion which is known as thermometric heat. Hence, the greater the number of molecules and the larger their dimensions, the greater the absorption of heat and the more the production of sonorous vibrations, for a greater number of air atoms will collide with warmed surfaces in a given time. That this assumption is justified is proved by the fact that this absorption of radiant energy renders the particles of dissociated nitrite of amyl and other vapours visible as well as warm, and therefore they can assume dimensions that are comparable with the particles of smoke.

MOLECULAR ELECTRO-MAGNETIC INDUCTION.

By Professor D. E. Hughes, F.R.S.

(Read before the Royal Society, March 17th, 1881.)

The induction currents balance which I had the honour of bringing before the notice of the Royal Society * showed how extremely sensitive it was to the slightest molecular change in the composition of any metal or alloy, and it gave strong evidence of a peculiarity in iron and steel which its magnetic properties alone failed to account for. We could with all non-magnetic metals easily obtain a perfect balance of force by an equivalent piece of the same metal, but in the case of iron, steel, and nickel it was with extreme difficulty that I could obtain a near approach to a perfect zero. Two pieces of iron cut off the same bar or wire, possessing the same magnetic moment, never gave identical results; the difficulty consisted, that notwithstanding each bar or wire could be easily made to produce the same inductive reaction, the time during which this reaction took place varied in each bar; and although I could easily change its balancing power as regards inductive force by a change in the mass of the metal, by heat or magnetism, the zero obtained was never equal to that obtained from copper or silver.

This led me to suppose the existence of a peculiarity in magnetic metals which could not be accounted for except upon the hypothesis that there was a cause, then unknown, to produce the invariable effect.

Finding that it would be impossible to arrive at the true cause without some new method of investigation, which should allow me to observe the effects from an electrical circuit, whose active portion should be the iron wire itself, I constructed an apparatus or electro-magnetic induction balance, consisting of a single coil reacting upon an iron wire in its axis, and perpendicular to the coil itself; by this means the iron or other wire itself became a primary or secondary, according as the current passed through the coil or wire. Now, with this apparatus we could induce secondary currents upon the wire or coil, if the coil was at any angle, except when the wire was absolutely perpendicular; in this state we could only obtain a current from some disturbing cause, and the current so obtained was no longer secondary but tertiary.

The whole apparatus, however, is more complicated than the general idea given above, as it was requisite not only to produce effects but to be able to appreciate the direction of the electrical current obtained, and

* *Proc. Roy. Soc.*, vol. xxix., p. 56.

have comparative measures of their value. In order to fully understand the mode of experiments, as well as the results obtained, I will first describe the apparatus employed.

The electro-magnetic induction balance consists—1st, of an instrument for producing the new induction current; 2nd, sonometer or balancing coils; 3rd, rheotome and battery; 4th, telephone.

The essential portion of this new balance (Fig. 1) is that wherein a coil is so arranged that a wire of iron or copper can pass freely through and forming its axis. The iron or copper wire rests upon two supports 20 centims. apart; at one of these the wire is firmly clamped by two binding screws; the opposite end of the wire turns freely on its support, the wire being 22 centims. long, having 2 centims. projection beyond its support, in order to fasten upon it a key or arm which shall serve as a pointer upon a circle giving the degrees of torsion which the wire receives from turning this pointer. A binding screw allows us to fasten the pointer at any degree, and thus preserve the required stress the time required.

The exterior diameter of the coil is 5½ centims., having an interior vacant circular space of 3½ centims., its width is 2 centims.; upon this is wound 200 metres

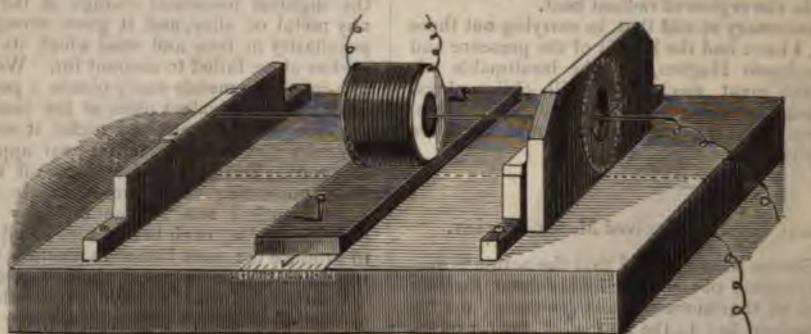


FIG. 1.—INDUCTION BALANCE.

of No. 32 silk-covered copper wire. This coil is fastened to a small board so arranged that it can be turned through any desired angle in relation to the iron wire which passes through its centre, and it can also be moved to any portion of the 20 centims. of wire, in order that different portions of the same wire may be tested for a similar stress.

The whole of this instrument, as far as possible, should be constructed of wood, in order to avoid, as far as possible, all disturbing inductive influences of the coil upon them.

The iron wire at its fixed end is joined or makes contact with a copper wire, which returns to the front part of the dial under its board and parallel to its coil, thus forming a loop, the free end of the iron wire is joined to one pole of the battery, the copper wire under the board is joined to the rheotome and thence to the battery.

The coil is joined to the telephone but, as in every instance we can either pass the battery through the wire, listening to its inductive effects upon the wire, or the reverse of this, I prefer, generally, in order to have no voltaic current passing through the wire, to join the iron wire and its loop direct to the telephone, passing the voltaic current through the coil.

In order to balance, measure, and know the direction of the new induction currents by means of a switching key, the sonometer* I described to the Royal Society is brought into the circuit. The two exterior coils of the sonometer are then in the circuit of the battery, and of the coil upon the board containing the iron wire or stress bridge. The interior or movable coil of the sonometer is then in the circuit of the iron wire and telephone. Instead of the sonometer constructed as described in my paper to the Royal Society, I prefer to use one formed upon a principle I described in *Comptes Rendus*, December 30, 1878. This consists of two coils only (Fig. 2), one of which is smaller and turns freely in the centre of the outside coil. The exterior coil being stationary, the centre coil turns upon an axle by means of a long (20 centims.) arm or pointer, the point of which moves over a graduated arc or circle. Whenever the axis of the interior coil is perpendicular to the exterior coil, no induction takes place, and we have a perfect zero: by turning the interior coil through any degree we have a current proportional to this angle, and in the direction in which it is turned. As this instrument obeys all the well-known laws for galvanometers, the readings and evaluations are easy and rapid.

If the coil upon the stress bridge is perpendicular to the iron wire, and if the sonometer coil is at zero, no currents or sounds in the telephone will be perceived, but the slightest current in the iron wire produced by torsion will at once be heard; and by moving the sonometer coil in a direction corresponding to the current, a new zero will be obtained, which will not only balance the force of the new current but indicate its value. A perfect zero, however, will not be obtained with the powerful currents obtained by the torsion of 2 millims. diameter iron wire, we then require special arrangements of the sonometer which are too complicated to describe here.

The rheotome is a clockwork, having a rapid revolving wheel which gives interruptions of currents in fixed cadences in order to have equal intervals of sound and silence. I employ four bichromate cells or eight Daniell's elements, and they are joined through this rheotome to the coil on the stress bridge, as I have already described.

The magnetic properties of iron, steel, nickel, and cobalt, have been so searchingly investigated by ancient as well as by modern scientific authors, that there seems little left to be known as regards its molar magnetism. I use the word molar here simply to distinguish or separate the idea of a magnetic bar of iron or steel magnetised longitudinally or transversely from

* *Proc. Roy. Soc.*, vol. xxix., p. 65.

the polarised molecules which are supposed to produce its external magnetic effects.

Molar magnetism, whilst having the power of inducing an electric current in an adjacent wire, provided that either has motion or a change in its magnetic force, as shown by Faraday in 1832, it has no power of inducing an electric current upon itself or its own molar constituent, either by motion or change of its magnetic moment. Molecular magnetism (the results of which, I believe, I have been the first to obtain) has no, or a very feeble, power of inducing either magnetism or an electric current in an adjacent wire, but it possesses the remarkable power of strongly reacting upon its own molar wire, inducing (comparatively with its length) powerful electric currents, in a circuit of which this forms a part.

In some cases, as will be shown, we may have both cases existing in the same wire; this occurs when the wire is under the influence of stress, either external or internal; it would have been most difficult to separate these two, as it was in my experiments with the induction balance without the aid of my new method.

Ampère's theory supposes a molecular magnetism or polarity, and that molar magnetism would be produced

wire. This effect I have repeated, but found the effects very weak, no doubt due to the weak battery I use, viz., four quart bichromate cells.

Sir W. Thomson shows clearly in his remarkable contribution to the *Phil. Trans. Roy. Soc.*, entitled "Effects of Stress on the Magnetisation of Iron, Nickel, and Cobalt,"* the critical value of the magnetisation of these metals under varying stress, and also explains the longitudinal magnetism produced by Wiedermann as due to the outside molar twist of the wire, making the current pass as in a spiral round a fixed centre. Sir William Thomson also shows clearly the effects of longitudinal as well as transversal strains, both as regards its molar magnetism and its electric conductivity.

My own researches convince me that we have in molecular magnetism a distinct and separate form of magnetism from that when we develop, or render evident, longitudinal, or transversal magnetism, which I have before defined as molar.

Molecular magnetism is developed by any slight strain or twist other than longitudinal, and it is only developed by an elastic twist; for, however much we may twist a wire, provided that its fibres are not

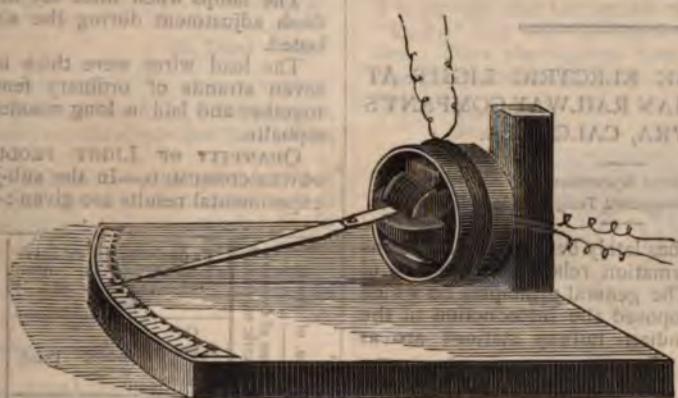


FIG. 2.—SONOMETER.—For first arrangement of Sonometer *see* TELEGRAPHIC JOURNAL, p. 180, vol. vii.

when the molecular magnetism became symmetrical; and his theory, I believe, is fully capable of explaining the effects I have obtained, if we admit that we can rotate the paths of the polarised molecules by an elastic torsion.

Matteucci made use of an inducing and secondary coil in the year 1847,* by means of which he observed that mechanical strains increased or depressed the magnetism of a bar inside this coil.

Wertheim published in the *Comptes Rendus*, 1852,† some results similar to Matteucci; but in the *Annales de Chimie et de Physique*, 1857,‡ he published a long series of most remarkable experiments, in which he clearly proves the influence of torsion upon the increment or decrement of a magnetical wire.

Vilari showed§ increase or diminution of magnetism by longitudinal pull according as the magnetising force is less or greater than a certain critical value.

Wiedermann,‖ in his remarkable work *Galvanismus*, says that an iron wire through which an electric current is flowing becomes magnetised by twisting the

* *Compt. Rend.*, t. xxiv., p. 301, 1847.
† *Compt. Rend.*, t. xxv., p. 702, 1852.
‡ *Ann. de Chim. et de Phys.* (3), t. l., p. 385, 1857
§ Poggendorff's *Annalen*, 1868.
‖ Wiedermann's *Galvanismus*, p. 447.

separated, we shall only have the result due to the reaction of its remaining elasticity.

If we place an iron wire, say 20 centims. long, 1 millim. diameter, in the axis of the coil of the electromagnetic balance, and if this wire is joined, as described, to the telephone, we find that on passing an electric current through the inducing coil no current is perceptible upon the iron wire; but if we give a very slight twist to this wire at its free end—one-eighteenth of a turn, or 20°—we at once hear, clear and comparatively loud, the currents passing the coil; and although we only gave a slight elastic twist of 20° of a whole turn, and this spread over 20 centims. in length, making an extremely light molar spiral, yet the effects are more powerful than if, using a wire free from stress, we turned the whole coil 40°. The current obtained when we turn the coil, as just mentioned, is secondary, and with the coil at any angle any current produced by its action, either on a copper, silver, iron, or steel wire; in fact, it is simply Faraday's discovery, but the current from an elastic twist is no longer secondary under the same conditions, but tertiary, as I shall demonstrate later on. The current passing through the coil cannot induce a current upon a wire perpendicular to itself,

* *Phil. Trans.*, May 6, 1878.

but the molecules of the outside of the wire, being under a greater elastic stress than the wire itself, they are no longer perpendicular to the centre of the wire, and consequently they react upon this wire as separate magnets would upon an adjacent wire. It might here be readily supposed that a wire having several twists, or a fixed molar twist of a given amount, would produce similar effects. It, however, does not, for in most cases the current obtained from the molar twists are in a contrary direction to that of the elastic torsion. Thus, if I place an iron wire under a right-handed elastic twist of 20°, I find a positive current of 50° sonometer; but if I continue this twist so that the index makes one or several entire revolutions, thus giving a permanent molar twist of several turns, I find upon leaving the index free from any elastic torsion, that I have a permanent current of 10°, but it is no longer positive, but negative, requiring that we should give an elastic torsion in the previous direction, in order to produce a positive current. Here a permanent elastic torsion of the molecules is set up in the contrary direction to its molar twist, and we have a negative current, overpowering any positive current which should have been due to the twisted wire.

(*To be continued.*)

REPORT ON THE ELECTRIC LIGHT AT THE EAST INDIAN RAILWAY COMPANY'S STATION, HOWRA, CALCUTTA.

By LOUIS SCHWENDLER,
Electrician of Government Telegraphs in India.

THIS report, which has lately been printed, contains much valuable information relative to the cost of electric lighting. The general principles on which Mr. Schwendler proposed the introduction of the electric light in Indian railway stations are as follows:—

"The station is to be lighted up by a certain number of powerful electric lights; each electric light being produced by *one* dynamo-electric machine and *one* electric lamp; the leading wires to be so thick that the least possible useless heat will be developed in them, and consequently the greatest possible useful heat in the lamps, in order to obtain the maximum light with the minimum power. By an opaque reflector each light is projected against the white ceiling from which it is diffused over a considerable area of the space to be lighted up; as far as practically possible no *direct* rays are allowed to enter the retina."

This method the author considered his experiments in London in 1877-78 clearly showed to give the best and most economical results, and later experiments, both in England and other countries, have verified this conclusion. The engine employed to drive the dynamo machines was a two-piston horizontal one of 25 horse-power, and worked at 50 to 65 revolutions per minute, with a steam pressure of 40 lbs.; native coal at rather less than 6 rupees (12 shillings) per ton was employed as fuel.

Since the regularity of any electric light depends in the first place upon the constancy of speed of the dynamo-electric machines, it is of paramount importance to be able to see at a glance the speed of the engine. By the aid of a Napier mercurial speed indicator it was possible to detect any v the speed *at once*, and to keep the e constant speed within 2 per cent.

The shafting of the dynamo-electric ma driven from the engine by means of Manilla ropes; these latter were used belting to avoid slipping, and answered tl well.

The following were the speeds for the fiv electric machines in use :—

Dynamo-electric machine.	No. of revolutions per minute of induction cylinder.	Speed of shafting.	Mercury speed indicator.
A ...	805	186	..
B ...	1,097		64
C ...	870		
D ...	1,042		
E ...	643		

The lamps when once set did not re fresh adjustment during the six months lasted.

The lead wires were thick iron ropes seven strands of ordinary fencing wir together and laid in long wooden boxes asphalte.

QUANTITY OF LIGHT PRODUCED AN POWER CONSUMED.—In the sub-joined ta experimental results are given :—

No. of circuit.	Name of dynamo-electric machine.*	Resistance in circuit at 80° F. not including resistance of arc. Ohms. Of dynamo-electric machine.	Of leading wires.	Total.	Length of leading wires in feet. (Iron rope) only.	Electric light dif
I.	A	0·584	·228	·812	238 × 2	[illegible]
II.	B	0·805	·247	1·052	358 × 2	[illegible]
III.	C	1·190	·280	1·470	475 × 2	[illegible]
IV.	D	1·423	·458	1·881	595 × 2	[illegible]
I.	E	0·622	·300	·922	238 × 2	[illegible]

Of these machines, A was spare and B E were used for lighting. Hence the lig standard candles is given for a consumpt horse-power, or total light of four lan 9,000 candles, or 720 candles per ho giving 19 standard candles per 100 s area. That this was a sufficient light wa bringing the light of an oil lamp or gas j shed. Any such light looked red com the diffused electric light.

As regards the cost of the light com gas, Mr. Schwendler gives all the items ture, but as these are entirely based upo of labour and material in India they are if any value in determining what the sa

* A, B, and E are Siemens dynamo-electric mach medium and B the small-sized machine; E is of the only altered according to my specification. C and D dynamo-electric machines.

cost would be in England. Under the best conditions, when the light is burning continuously, the cost is shown to be as about 9 to 1 in favour of the electric light; under the most unfavourable conditions, that is, when the light is but little used, and when the cost for labour in attending to the machinery remains still the same, then the economy is as 1 to from 1·5 to 3·7 in favour of the electric light.

The cost of gas is taken as 10s. per 1,000 c. feet. In England the cost of gas is of course much less, and the cost of labour for attending to the machinery is greater, thus the labour in India is estimated as follows:—

Kind of labour.	Salary per month.	Half the salary per day is charged to the electric light when burning.
Engine driver ...	29 Rs. ...	0·483
Oiler	16 " ...	0·267
Fireman	9 " ...	0·150
Cooly	9 " ...	0·150
Durwan	7 " ...	0·117
		Rs. Total 1·167

The cost of coal is rather less than 6 Rs. per ton, or 1·159 Rs. per hour; carbon electrodes for 4 lamps, ·503 Rs. per hour.

That the electric light is better adapted for a hot country like India than ordinary combustion light is clear from the fact, established by the author's London experiments, that the electric light produces at least *fifty times less* heat than if the same light is produced by the combustion method (gas, oil, or candle light).

TELEGRAPHIC APPARATUS IN USE IN THE BRITISH POSTAL TELEGRAPH DEPARTMENT.

XXX.

THE WHEATSTONE AUTOMATIC SYSTEM.

(*Continued.*)

THE FAST DUPLEX REPEATER.

THE most complicated arrangement of apparatus employed in connection with the Wheatstone Automatic System is, perhaps, the "Fast Speed Duplex Repeater;" this combination is shown by fig. 123.

The complete set comprises:—One Wheatstone receiver; three standard relays; two sounders; two keys; two rheostats with condensers; one "leak" rheostat; two galvanometers; two rheostats; two plug switches; one bar switch; in addition, of course, to the batteries.

When the plugs are inserted in switches, s^w1 and s^w2, and the bars of the bar switch, F, are in the position shown in the figure, the apparatus is arranged for working as a duplex repeater, and in order to understand its action we must consider what is necessary in order that duplex repetition may be carried on.

Supposing that we have two relays, A and B, at the repeating station, A being connected to the "Down" line and B to the "Up" line. Now, if we suppose the tongue and contacts of relay, B, to be simply a double current key, and if we also suppose its local connections to be joined up to relay, B, and to the "Down" line, as in an ordinary double current duplex (Article XI., June 15th, 1880), then it is obvious that all the signals sent from the distant station on the Down line will be properly received on relay, A, whilst the signals sent by the tongue of relay, B, will also be properly received at the station on the Down line. It is the same thing whether the tongue of relay, B, sends out reversals, like an ordinary double current key, or whether it sends them out by means of a split battery earthed in the middle.

If we connect the line connections of relay, B, to the "Up" line, then the signals received from the "Up" line will obviously be repeated, by means of the tongue of relay, B, as before explained, on to the "Down" line; and, again, if the tongue of relay, A, be connected to the relay, B, and the "Up" line in the ordinary double current duplex manner, then it is obvious that the signals received on A from the "Down" line will be repeated on to the "Up" line. Thus the signals from either line will be repeated without confusion.

RECEIVER ON DOWN LEAK. RECEIVER ON UP LEAK.

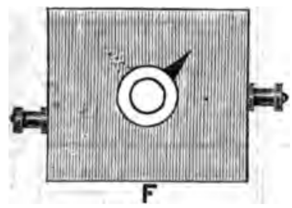


FIG. 124.

The general arrangement of the relays, galvanometers, and rheostats, may be seen from fig. 122. The keys, N_1, N_2 (fig. 123), which are similar to those employed in the fast repeater (Article XXVIII.), are joined on to the relays, A and B, so that their movements imitate the motions of the tongues of these relays, and thus enable signals to be sent by hand when required. Key, N_2, corresponds to the tongue of relay, B, and key, N_1, to the tongue of relay, A. The switches on the keys shift the relay coils from the tongues of the relays, to which they are connected, on to the levers of the keys; thus the switch of key, N_2, when in the position shown in the figure, connects the "split" of the coils of relay, A, on to the tongue of relay, B; but when moved over to the left, the "split" of A becomes connected to the lever of the key.

As it is very important that proper balance should be maintained on the rheostats, in order that the signals may be properly repeated, means similar to that employed in the fast repeater system are adopted for the purpose. C is a standard relay, whose terminal, U, is connected, through the medium of the bottom bar of the switch, F, with the tongue of relay, B; terminal, D, of the relay, C, is connected to earth through the medium of the second bar of switch, F, and the lower set of resist-

FAST DUPLEX REPEATER.

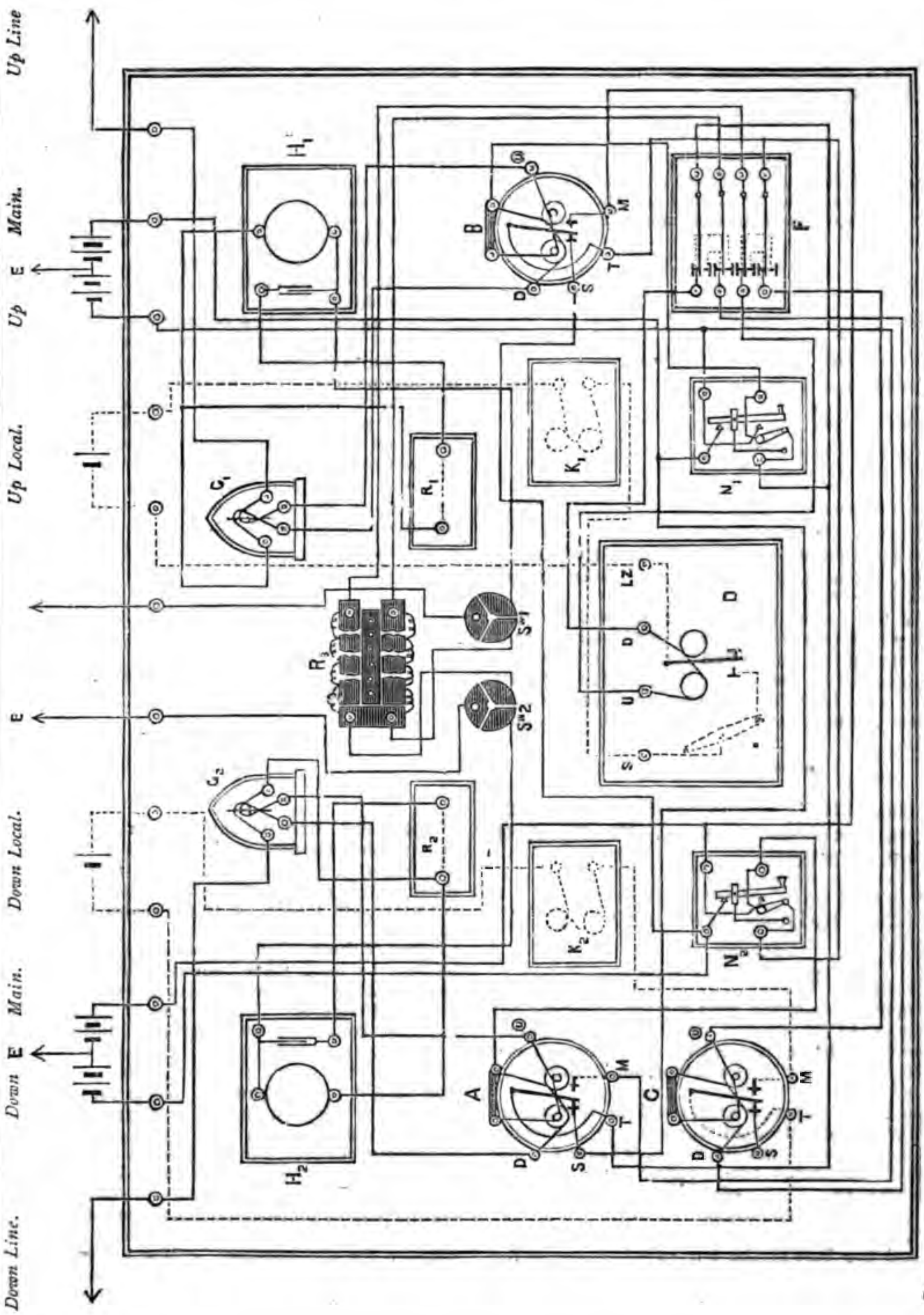


Fig. 123.

ances in the leak resistance box, R_2. Thus, a portion of the current sent out by relay, B, acts on relay, C, and shows whether the signals are being obtained correctly. The movements of the tongue of relay, C, work the local sounder, K_2.

The Wheatstone transmitter, D, is connected with the tongue of relay, A, the circuit being completed through the medium of the top and third relay, B, now becomes connected to the tongue of relay, A, whilst the Wheatstone transmitter, D, becomes connected to the tongue of relay, B. It will be observed that on making these changes the line and earth connections must be reversed; this the switch accomplishes. By this arrangement, the full speed signals, either to the Up or Down line, can be read off by means of a single Wheatstone

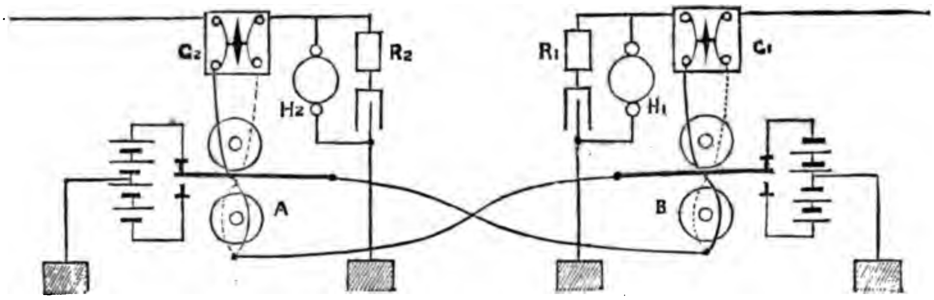


FIG. 122.

bar of the switch, F, and through the upper set of coils in the leak resistance, R_2; thus the currents sent out by relay, A, are registered by means of the Wheatstone transmitter and the local sounder connected to the latter.

If now the bars in the switch, F, be all moved from their top to their bottom contacts, then relay, C, which was originally connected to the tongue of receiver. It is never required to read from both lines at the same time, though it is necessary that either line should be able to call the repeater station, and this is provided for by the use of the two sounders.

Fig. 124 shows an end view of the bar switch box, showing the button by the turning of which the connections become changed.

Notes.

SWAN'S ELECTRIC LAMP.—On Thursday evening there was a large attendance of ladies and gentlemen at the Philosophical Society's rooms, Glasgow, when Mr. Swan again took the opportunity to explain the chief features of his lamp for the benefit of the fair sex, knowing well that if he could but gain their approbation to the introduction of his lamps, success would be his. His remarks were very clearly and plainly stated, and all present were highly delighted. Mr. Swan has been quite lionised during his short stay in Glasgow. We understand that Messrs. D. and G. Graham, of the Telephone Exchange, have become the agents for Scotland for the Swan Electric Lighting Company, and that already they have booked an order to light up the house and well-known colliery belonging to Mr. Watson, of Earnock, besides having obtained promises of several private mansions on Swan's principle. It is stated that 250 candle-power can be obtained for each horse-power expended.

THE INFLUENCE OF THE AURORA BOREALIS OF AUGUST, 1880, UPON TELEGRAPHIC CONNECTIONS.—By Herr Ludewig, of the Imperial German Post-Office.—The author remarks that thunderstorms and the aurora exert an injurious effect, more or less, equally upon telegraphic connections, whether suspended in the air or buried in the ground. The auroral disturbances are not very frequent, but when they occur they extend over a very large portion of the surface of the globe. Electric storms are generally very local, but are injurious by reason of their frequency. A remarkable difference is that the auroral perturbations affect chiefly the longer telegraphic lines, and thunderstorms the shorter ones. The author then gives an account of the intense magnetic disturbance, from the 11th to the 14th of August last. The perturbation extended over the entire northen half of the eastern hemisphere, and even penetrated beyond the equator to Mozambique and Natal. In America brilliant displays of the northern lights are recorded from a number of places; but there is no mention of any interference with the telegraphic service. In Europe the disturbances took the form of strange currents, so called earth-currents, varying in intensity, duration, and direction. In Germany almost all the long lines were thrown out of order from about noon, August 12th. Single characters, and even whole words, were often wanting; and in the Morse instruments the armature occasionally remained fixed, so that unbroken lines appeared on the paper. The needles in the galvanoscopes were deflected, first to one and then to the other side, and often remained from five to ten minutes in a divergent position. The Berlin-Hamburg (underground) and Berlin-Warsaw (above ground) lines were almost unaffected, though the cable from Hamburg to Norway was greatly disturbed. General perturbation was experienced in Britain, France, and Spain. In one of the cables from Marseilles to Algiers strong earth currents were observed, whilst the second parallel cable was unaffected. In Norway correspondence was rendered partially impossible, though the cables to Scotland and Denmark were not hindered. Switzerland was little affected, and Italy and Austria apparently not at all, though the line from Cracow to Warsaw was interrupted from 1·0 to

10·20 p.m., August 12th, in consequence of violent thunderstorms. In Russia the disturbance was felt from the western boundary to the shores of the Pacific. Attention is drawn to the fact that this magnetic storm occurred during the time of the August meteoric shower, and that it coincided with a maximum in the periods of the solar spots.

ON the 24th ult. a paper on "The Future Development of Electrical Appliances" was read before the Society of Arts by Professor John Perry.

TELEPHONIC COMMUNICATION BETWEEN THE HOUSES OF PARLIAMENT AND THE PRIVATE RESIDENCES OF MEMBERS.—The Postmaster-General stated, in answer to Mr. Bourke, that should the Commissioner of Works be able to find sufficient room in the House for this purpose, he would be prepared to establish telephonic communication at the following rates:—For a distance of half a mile, £15 per annum; one mile, £19 per annum; and for each half mile beyond a mile, £4 extra.

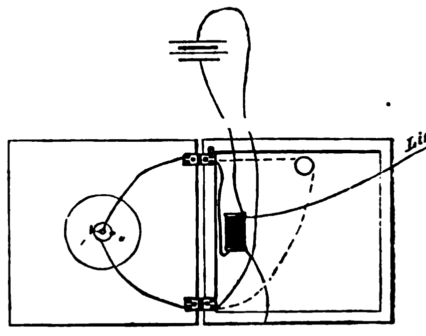
PETITIONS from the Inverness Town Council, praying for direct telegraphic communication with London, and from the Wick Town Council for direct communication with Aberdeen, have been presented to the Postmaster-General.

TELEPHONIC SYSTEM WITHOUT CONDUCTING WIRES.—Signor Senlicq d'Ardres communicates an idea suggested by the photophone for obtaining the transmission of sounds without conducting wires. The sounds are emitted by means of a mouth-piece like that of Edison for conveying speech to a distance and to cause them to arrive at a large concave reflector which receives a relatively large proportion of the sound-waves, and concentrates them at its focus, which is occupied by the mouth-piece of a microphonic speaker, rendered much more sensitive by a contact lever with unequal arms. The short arm of the lever corresponds to the vibratory plate of the speaking instrument, and the long arm to the contact of the movable carbon.—*Il Progresso.*

MEASUREMENT OF THE DIFFERENCE OF POTENTIAL BETWEEN TWO METALS IN CONTACT.—It is known that the contact theory of Volta, after being abandoned for a long time in favour of the electro-chemical theory, has been for some time again taken up by physicists, and that they have succeeded not merely in demonstrating that the simple contact of the bodies with each other may develop electromotive force, but even to measure this force, or, what comes to the same thing, the difference of potential between the bodies in contact. According to Signor Pellat, the electromotive force of contact varies according to the physical state of the metallic surfaces. Thus between copper and zinc washed with absolute alcohol the force in question is 0·75 volt.; but between the same metals rubbed with the finest emery paper and then washed with absolute alcohol it is 0·90 volt. The metals generally become more positive as their temperature increases and more negative as it falls. The electromotive force of contact varies likewise with the physical conditions of the air interposed between the two discs.—*Il Progresso.*

MR. GEORGE D'INFREVILLE of New York has patented a method of counterbalancing the effects of the charge current in a duplex telegraph system, by momentarily diminishing the normal resistance in the artificial line simultaneously with the act of charging the main line.

A PATENT (of which we give an illustration) has been taken out in America by Francis Blake for a battery telephone, in which microphones are placed in the two arms of a Wheatstone bridge, so that the variation in



the resistances can produce a greater relative effect than would be the case if the microphones were placed in an ordinary circuit.

ON March 11, in the High Court of Justice, Chancery Division, before Vice-Chancellor Bacon, the case of the Edison Telephone Company *v.* the India-Rubber and Telegraph Works Company was mentioned. This had reference to an action brought for alleged infringement by the defendant company of Edison's patent for *carbon* telephone transmitters. An application was made by the defendants for leave to amend their particulars of objections. Reference was made to several journals to prove prior publication of the invention in this country; amongst others the TELEGRAPHIC JOURNAL for the 15th February, 1877. On behalf of the plaintiff company, it was submitted that the application ought not to be granted, except upon the terms of an order upon the defendant company to pay the plaintiffs' costs in the event of their electing to discontinue the action. His Lordship made the order that the defendant company pay the costs of the application, and the cause to stand over generally, with liberty to the parties to apply to restore it to the paper if necessary; the plaintiff company, however, should have one month instead of six weeks within which to elect to discontinue or not.

ON March 19, before the Master of the Rolls, the case *Re* the Telephone Company (Limited) was heard. This was a petition by the Right Hon. E. P. Bouverie, the owner of 100 shares in the above company, which is in course of voluntary liquidation for the purpose of being amalgamated with the Edison Telephone Company, asking for the removal of the liquidator of the above company, who was also a director in order that certain transactions by the directors of the company, which were alleged to be *ultra vires*, might be investigated by an independent person. Mr. Chitty, Q.C., and Mr. Romer appeared for the petitioner; Mr. Davey, Q.C., and Mr. Kirby for the liquidator; and Mr. Ince, Q.C., for other parties. The Master of the Rolls directed that the petition should stand over generally to allow of a meeting of the shareholders of the company to be called by the liquidator, when the following questions were to be submitted:—First, whether the shareholders desired proceedings to be taken in the name of the company to impeach the transactions; secondly, whether they were willing that proceedings should be taken in the name of the company at Mr.

Bouverie's risk and expense, but for the benefit of the company. The capitalist shareholders were not to vote at such meeting. If Mr. Bouverie objected to take the order in that form the petition was to be dismissed with costs.

CONTRIBUTIONS TO THE THEORY OF THE MAGNETISATION OF STEEL.—By A. Righi.—The measurement of the magnetism took place in the well-known manner, by placing the magnet-bars in a coil in front of the mirror-magnet of a compass, the action being compensated by a second spiral placed behind the mirror and traversed by the same current. The permanent magnetism was determined after opening the circuit, the magnet being approached to a certain distance from the mirror. In this manner the author observed the following facts, which he speaks of as "laws." The permanent magnetism of a bar increases a little if it is surrounded with a metallic covering, the more so the thicker the covering, the shorter and thicker the rod, and the smaller the number of turns in the magnetising spiral. If the circuit is slowly closed and quickly opened a rod inclosed in a metal tube acquires more permanent magnetism than if it lay alongside the tube. If the circuit is closed quickly and opened slowly the reverse rule holds good. A steel bar placed in an iron tube becomes less magnetic if the tube is entire than if it is slit. The difference is the more considerable the feebler the current, and disappears on closing slowly. Magnetism penetrates into a steel rod the more slowly the circuit is closed. (The author has sought to demonstrate this by dissolving away portions of the metal, which completely alters the distribution.) If the circuit is quickly opened the magnetism of the bar is decreased, especially in the superficial layers. Consequently it can remain more strongly magnetised in the interior than in the strata near the surface, or it may show an opposite polarity in the latter. The properties of a bar demagnetised by an opposite current do not always depend on strata magnetised in a reverse manner. They are not formed if the circuit is opened and closed more slowly. These results are referred to the induction currents produced in the mass of the coatings and bars; at the same time, owing to the reciprocal action of the molecules, the internal molecules revolve more slowly. The temporary magnetism of a bar is the greater the more rapidly the circuit is closed. The increase of the temporary magnetism due to rapid closing, as compared with slow closing, is greater when a counter-current acts prior to closing. The temporary moment of a steel bar, owing to a current of a given intensity, is greater if a stronger, but gradually diminished, current is previously allowed to act. The permanent magnetism of a steel bar is the greater the more quickly it is subjected to the action of the current, as, *e.g.*, in an instantaneous closing of the circuit as compared with a slow one. The difference between both results the shorter the wire of the magnetising coil. The permanent magnetism of a steel bar is the greater the more slowly it is withdrawn from the magnetising action, as in opening the magnetising circuit rapidly or slowly. If two equal bars differing in hardness are magnetised simultaneously the decrease of the magnetism from their reciprocal action is greatest in the softer bar. If a circuit is slowly closed and quickly opened the softer bar receives more magnetism, but the harder if it is quickly closed and slowly opened. Hence the displacement of the molecules takes place, *ceteris paribus*, more rapidly in soft steel. If two bars of different thickness are magnetised simultaneously, the thicker one is most affected by their reciprocal action. In case of tubes inserted into each other the opposite results are obtained. If shorter and shorter bars of a given thickness are magnetised the permanent magnetism first decreases to null with decreasing length, and then becomes reversed. The feebler the current the greater the length at which the inversion takes place. With an increasing intensity of the current the reversed magnetism increases first to a maximum, decreases then to null, and finally passes over into normal magnetism. Inversion appears only if the circuit is rapidly opened. In case of quick closing inversion does not appear if the intensity of the current is slight, but it is still manifested on closing slowly. The influence of this kind of closing is the plainer the smaller the number of turns of the magnetising spiral. If on opening the current the bar occasions induced currents in an adjacent metallic mass the polarity either remains inverted, though more feeble, or normal magnetism appears. If a steel disc is magnetised in the direction of one diameter and is then exposed to magnetising force in another direction, the direction of the polarity is displaced further and further with the growing intensity of the second force. The same takes place with the increasing angle of the two directions of magnetisation when the second force exceeds a certain limit. If, on the other hand, the second force is small enough, the displacement decreases with the growth of the angle down to 90°. The angular displacement of polarity by a second force, forming with the first an angle of 90°, is the greater the more quickly the circuit is closed and the more slowly it is opened. If the disc revolves between the magnetising spirals it always retains a certain magnetism which does not correspond to the diameter which lies in the direction of the lines of force on opening the circuit, but is displaced in the direction of the rotation, though to a less degree, the greater the intensity of the current.—*Weidemann's Beiblätter.*

THE Clyde Spinning Company (Glasgow) have introduced the electric light into one of their flats with a view of testing its adaptability to such work. The cotton works at Deanston are about to adopt the electric light.

BEFORE the Royal Society, Edinburgh, on February 21, Prof. Fleeming Jenkin in the chair, Sir William Thomson communicated a paper by Mr. Witkowski on the effect of strain on electric conductivity. A cylindrical brass tube, with a magnet and attached mirror suspended horizontally in the centre at right angles to the axis, was traversed from end to end by an electric current. In its original unstrained isotropic condition the cylinder so conducted the current that the inclosed magnet was unaffected. A couple was then applied in a plane at right angles to the axis, so as to distort the metal tube by a definite twist, thus rendering it æolotropic as regards its electrical conductivity, and giving to the current a spiral set, which was evidenced by the deflection of the suspended magnet. The lines of flow set spirally round in a direction contrary to that of the applied couple—a result in complete accordance with the theory of twists, which requires a lengthening (and therefore an increase of resistance) along spiral lines that set round with the couple and a simultaneous compression (and corresponding decrease of resistance) along lines at right angles to these. Quantitative results were obtained by balancing the electro-magnetic action of the current in the strained tube by means of an external circular movable conductor traversed by a steady current. Sir William Thomson described certain experiments which he had lately made on the effect of moistening the opposing surfaces in a Volta condenser, and of substituting a water arc for a metallic arc in the determining contact. The main features of the paper were, the non-existence of any measurable difference of potential when contact

was made by means of a drop of clean water between opposed polished surfaces of zinc and copper, the effect of oxidising the surfaces in the pure metallic contact experiment, and the exact similarity in the action of dry polished zinc and wet oxidised zinc when opposed to dry copper and brought into contact by a metallic arc.—*Nature.*

THE Central Telegraph-office at Amsterdam is lighted by the Von Hefner-Alteneck system of electric lighting. The result is said to be very satisfactory.

A SUBTERRANEAN cable of 12 wires is being laid between Nancy and Paris. The cable is inclosed in a cast iron tube, with flush boxes every 500 metres.

THE ELECTRIC LIGHT IN THE CITY.—The following details show the arrangements of the electric lighting system which will be carried into operation from the commencement of the present month:—

Name of Contractor.	Length of Circuits. Position of Generator.	Number of Lamps.	Number and Kind of Machines.	Engines.	Horse-power of Engine.	Conductor.
The Anglo-American Electric Light Corporation. (Brush system.)	Single circuit of 20,000 feet. Generator at Vine-street, Lambeth.	32	1 forty-light Brush machine.	Brotherhood or Galloway, one being always in reserve.	Either 28 *indicated*	7 No. 16 B.W.G. stranded.
Siemens Bros. & Co., Limited.	Generators at Swan-lane, Thames-street. The lamp furthest from the generator is distant about ½ mile.	6 powerful, at an altitude of 80 feet. 28 of about 300 candle-power, at an altitude of about 20 feet. Carbons to last 18 hours.	One machine to each lamp. Two alternate current for the 28 lamps, the latter being divided into 4 groups of 7 lights each, 2 groups to each machine.	2 Marshall & Co.'s., a third by the same makers being always in reserve.	20 *nominal* each.	Copper, covered with gutta-percha, laid in cast-iron pipes, except on London Bridge where wires lie on parapet.

THE PHOTOPHONE.—Writing to *Nature*, Mr. Herbert Tomlinson says:—"Three years ago, while experimenting on the action of radiant heat and light on the electrical resistance of substances, I was induced to believe that coating selenium with varnish or lamp-black would largely increase its sensibility to light. I therefore annealed a stick of selenium about 2 cm. in length and 5 cm. in diameter, having previously melted into each end a platinum wire, and thus obtained a specimen which, though of very high resistance, was exceedingly sensitive to the action of light. The effect of diffused daylight was tested in the following manner:—The specimen was placed in a glass box and connected directly with two Leclanché cells and a very delicate Thomson's galvanometer, having a resistance of 6,000 ohms; a deflection of, as far as I now remember, about 300 divisions of the scale was produced, and the light was then brought to zero by means of the adjusting magnet; a dark blind which had previously been drawn down was now pulled up, and the result was a deflection of about 100 divisions in the same direction as before. The glass box was placed three yards in front and a little to one side of the window, which was closed, and the sun at the time (about 4 p.m., July, 1877) was on the other side of the house. The selenium was then coated with shell-lac varnish, and about two hours afterwards again tested in the same manner as before, when the light was found to produce a deflection of 220 divisions, or more than twice the previous amount. The action of radiant heat was similar to that of light in the case of this particular specimen, but I have little doubt that *any* specimen may be rendered more sensitive to light by coating it with varn'sh or lamp-black."

THE Central and South American Cable Company has contracted with the Governments of Costa Rica and the United States of Columbia for a line across the Isthmus of Panama, and a working party has left Vera Cruz to make surveys and enter upon the construction of a line across the Isthmus of Tehuantepec. From thence lines will connect through Nicaragua and Guatemala, opening communications with the entire West Coast.

A PRIZE of £25 has been offered by Mr. James Johnston, of Edinburgh, for an explanation of the nature of electricity; the prize to be awarded by the Congress of Electricians at Paris.

THE PARIS INTERNATIONAL ELECTRICAL EXHIBITION, 1881.—The following letter has been circulated. SIR,—At the instance of the Society of Telegraphic Engineers and of Electricians, I have undertaken, with the concurrence of M. Berger, the Commissaire-Général of the forthcoming Exposition d'Electricité, to do all in my power to aid the exhibitors in the British section, in the allotment of space, the arrangements for the reception of the exhibits, and the procuring, if required, of tables, stahds, or other appliances necessary for the proper instalment of their exhibits. For any actual cash disbursements on behalf of the exhibitors I shall, of course, require to be paid; but so far as my personal services are concerned they will be at your command, free from charge, as are my services, as local honorary secretary in Paris to the Society of Telegraph Engineers and Electricians. I may mention that the Commissaire-Général has promised me his support in these matters, and has kindly intimated his intention of providing me with a suitable office in the building when ready for the reception of exhibits; meanwhile I shall be happy to attend to any communications addressed to me.—I am, Sir, yours obediently, J. AYLMER.

ELECTRIC LIGHTING.—The Inman Steamship Company's ship, the *City of Paris*, having been fitted with new engines, will shortly commence running to New York. She has also been fitted with the electric light in the steerage, the system employed being the same as that which has given so much satisfaction on board the *City of Berlin*. The whole of the work has been

furnished and applied by the Electric Lighting Supply Company, under the superintendence of Mr. Killingworth Hedges, C.E.

The Telegraph Clerks and the Government.—On Saturday night two meetings of postal telegraph clerks were held at the Foresters' Hall, Aldersgate-street, the aggregate attendance being about 1,500. Mr. A. S. Coates occupied the chair, and addressed the audience upon the subject of the recent deputation to the Postmaster-General. Mr. Slingo, on moving a vote of confidence in the committee appointed to conduct the agitation, advised the men to be united and prepared for an unfavourable decision with regard to their claims. He stated that great dissatisfaction was felt throughout the country at the manner in which the deputation had been received, and the London committee had had the greatest difficulty in preventing the provincial clerks from striking. It was agreed that a statement should be prepared and issued to the public, and also that a general conference should be called within a limited period to decide upon the course to be adopted in the event of an early and satisfactory reply not being received from the Postmaster-General. Resolutions were also passed pledging the meeting to support any and every action of the committee, and also to act in unison with the provincial staffs, one speaker stating that if those telegraph clerks "struck" it would be the duty of the London men to follow their example. The meeting terminated with the passing of a vote of thanks to Mr. Macliver, M.P., who, with other members of the House of Commons, has been very earnest in his representations to the Postmaster-General upon the subject. A meeting of telegraph clerks was held in Leeds on Saturday evening, at which delegates from various other towns were present. The report of the delegates who waited upon the Postmaster-General on Tuesday was presented, and called forth general condemnation. A resolution was unanimously passed pledging those present to support the Liverpool Committee in any action they may think fit to adopt with reference to the claims of the clerks to be placed upon a proper status as civil servants of the Crown. A similar meeting was held on Saturday evening at Newcastle-on-Tyne. At a meeting held at Bristol on Saturday resolutions were adopted expressing surprise and regret at Mr. Fawcett's conduct, and postponing definite action until the subject had been brought before Parliament on the Post-Office Estimates. The tone of the meeting, however, was distinctly in favour of carrying on the fight to the end. A premature disorganisation of a service so essential to the public was condemned, and it was determined not to take extreme measures until all other measures had failed. But it was quite understood that extreme measures might become necessary, and the Central Committee was requested to call together representatives of the whole service when final action was to be taken. The meeting was very enthusiastic and determined, and numerous telegrams were received in sympathy from different parts of the country.—*Daily News*, March 21, 1881.

The invention of the telephone is likely to prove a considerable source of profit, if not to the inventors of the same at least to the members of the legal profession. There are many signs of a great commotion in the telephone world, caused either by the ignorance of patent agents of the proper way to draw up a patent specification, or by the promoters of telephone companies not ascertaining the conditions under which they can make use of the articles they supply.

The rights and wrongs of the carbon transmitter question are likely soon to come to the point. Notice has been given of a petition for leave to enter a disclaimer and memorandum of alteration of certain parts of Mr. Edison's patent for "Improvements for controlling by sound the transmission of electric currents, and the reproduction of sounds at a distance." In addition the United Company threaten proceedings against the British Gower-Bell Company for infringement of the said Edison patent, to which the secretary of that company writes:—"In reply to an announcement by the United Telephone Company, the secretary of the Gower-Bell Company states that the value of the allegation that proceedings will be taken for infringing the Edison patent may be measured by the facts that the United Company did commence five actions on that ground, which were withdrawn, and that should legal proceedings be renewed, this company's directors are satisfied that they have a complete defence, and that the positions intended to be taken by this company, as indicated in the prospectus, can and will be maintained."

The annual amount paid for gas consumed by the public lamps of the City of London is about £14,000. The amount agreed upon for the electric lighting, by way of experiment, of three districts for twelve months, from sunset to sunrise, is £8,060. It is roughly estimated, says the *Citizen*, that the cost of the experiment including the plant, machinery, fixing, replacing, and so on, will be about four times the price now paid for gas; but eliminating these expenses, which would not be recurrent, the cost would only be twice that of gas. In the districts where the experiment is in operation gas will not be used unless the electric light should fail.

A new organisation, styled the New York Electrical Society, has lately been organised in that city, having for its object the advancement of the knowledge and uses of electricity. The following officers were elected for the ensuing year:—President, F. W. Jones; Vice-presidents, George B. Scott, Prof. Vander Weyde, Gerritt Smith, W. J. Dealey, George A. Hamilton, and G. G. Ward; Secretary, John W. Moreland; Treasurer, M. Brick. The membership is already quite large, and comprises many of the foremost electricians residing in the vicinity of New York.

An association of electricians is being formed in Spain.

A Telephone Reissue.—The Patent Office, after careful hearing, has granted to Mr. E. Berliner, a reissue of his original telephone patent, of January 15, 1878, with several new claims, among which is one that virtually awards to the above author the priority of invention and use of the local battery in conjunction with telephone instruments. Prior to the invention of Mr. Berliner it was necessary to yell very loud in order to make anybody hear at any considerable distance through the telephone, and even then the speaker's voice was heard quite faintly. But now, with this improvement added, the telephone is rendered so sensitive that conversation in whispers may be readily carried on, and the ordinary tones of conversation are delivered by the instrument in the most perfect and admirable manner. Mr. Berliner is entitled to the highest honour for his remarkable invention, which is now used in all parts of the world. The patent is held by the National Bell Telephone Company, of Boston, Mass.—*Scientific American*.

The latest date for applications for space in the Exposition Internationale d'Electricité is to be April 15th, instead of the 31st ultimo.

Proceedings of Societies.

PHYSICAL SOCIETY.—March 12th.

Sir W. Thomson in the Chair.

New members—Mr. Colville Brown, Dr. J. P. Joule.

Colonel Festin read a paper by Captain Abney and himself, on the absorption spectra of organic bodies. The method of photographing the infra-red region of the spectrum gave better results for absorption than the thermopile. Organic compounds were chosen as giving larger molecules. The apparatus employed consisted of a small Gramme machine driven by a Brotherhood engine, and an electric lamp with a device for shifting the negative pole so as to get the crater on one side of the other carbon point. The image of the positive pole was allowed to fall on the slit of the spectroscope: the light of the arc not being used. Three prisms were used and a camera with a back-swing to it, so as to get a considerable length of spectrum in focus. Maps of the various spectra were made with six inches of the substance examined inclosed in a glass tube. Alcohols, acids, oils, and water were examined, and gave spectra of bands and lines. When hydrogen was absent in the compound there were no lines, and the authors conclude the lines to be due to hydrogen. Oxygen appeared to obliterate the space between two lines and make it a band. The authors hope by this method to detect the radicles present in a substance. They found correspondencies between some lines and lines in the solar map.

Dr. Coffin said that two kinds of chloroform, apparently the same, produced different physiological results: the method might distinguish between these.

Sir William Thomson thought it might throw light on the ultimate constitution of matter.

Mr. Brown read a paper on the "Definition of work in Text-books," and gave reasons for preferring that in Rankines' books.

THE SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.

An ordinary general meeting of this Society was held on Thursday, March 24th, Professor Carey Foster, President, in the chair. The minutes of the last general meeting having been read and confirmed, and the list of new and proposed members read, it was announced that the council were making arrangements for issuing invitations to members to meet Professor Helmholtz at a reception to be held shortly.

A paper by Mr. J. Morris, member, local honorary secretary and treasurer for Japan, on "Telegraphs in Japan," was read by the Secretary.

The author commenced by saying that it was only about nine years ago that Japan had become a well-known country. About that time seventy miles of railway were constructed, and iron, gold, and silver mining were actively prosecuted. Good roads were much wanted to enable the resources of the country to be developed. The erection of telegraphs had had a very beneficial effect in enabling insurrections to be quelled.

In 1869 forty miles of line, worked by Breguet's A B C instruments, were in operation. In 1871 a general system was planned out and surveys made, and in one year materials for the construction of 900 miles of line were ordered. Great difficulties were experienced from the hostility of the inhabitants in opposing the erection of the lines. Old timber was at first used for the poles, which perished in about four years or less, but these were replaced by better wood. Cedar was the kind of wood employed most extensively. Iron poles were too expensive. The life of the cedar wood varied according to the soil in which the poles were planted. Tarring the poles was tried with some success, but tar was difficult to obtain. As timber and labour were both cheap it was best to renew the poles from time to time. Boucherising was tried lately with success. Creosoting was too expensive. Since 1871 Morse instruments had been employed on all the lines, the Siemens pattern being adopted. On the longest line a translator was employed, but direct working had been carried on with 80 Daniell cells and with relays wound to 900 ohms resistance. Single needle instruments were used only on railways; but these were being replaced by the Morse except for block working. The insulators were of the Varley double shed pattern fixed on iron brackets, but arms have since been used. Single cup insulators of native manufacture are now used very largely, the standard of insulation being 40,000 megohms. A cable 1,350 yards long was laid across between two islands. A wire stretched across was first tried, but was carried away by the mast of a vessel. Siemens plate dischargers were placed at the ends of the cable. Open wires on poles were laid across some creeks, the poles being protected by massive timber breakwaters; the spans were 450 yards of No. 11 wire.

In 1879 there were 3,929¼ miles of line, and 9,345 miles of wire in working order. In 1871 a school for teaching operators was started; and in 1880 227 of the latter had been appointed and 97 were under tuition. English, French, &c., formed a part of the instruction course.

A difficulty in signalling arose from the absence of a regular alphabet in the Japanese language. Forty-seven signs were employed for the purpose. The maintenance of the lines was such that it was rare for a fault to be of longer duration than one half a day. In ten months there were 153 faults of 6 hours' duration, 85 of 12 hours, 27 of 24 hours, and 21 exceeding that time. The linemen had each charge of about 30 miles of line.

The rice trade had benefited considerably by the telegraph, and owing to the communication it was possible to send food at once to famine-infected districts instead of it being necessary to keep large stores of rice as was formerly the case.

In 1879 the receipts were £108,323, against £101,674 expenses. This was the first year in which the receipts exceeded the expenses. The total number of messages forwarded was 1,272,756, 96 per cent. being Japanese. The tariff was too low at first to prove remunerative. Twenty characters could be sent thirty miles for a penny. Several new cables had recently been laid down. Tests of the wires were taken twice a week with a tangent galvanometer, and Wheatstone bridge measurements for conductivity were also made. The insulation of the lines averaged 1½ megohms. Spiders were very troublesome in lowering insulation. In 1879 112 ordinary offices were opened and 70 railway offices.

Specimens of telegraph material of native manufacture were exhibited, and notably some copper wire insulated with lacquer alone.

At the conclusion of the paper a short discussion ensued, in which Messrs. Betts, Dresing, and Preece took part, the meeting then adjourned till the 14th April.

New Patents—1881.

"Signalling apparatus for railway trains." H. DAN. (Communicated by H. Ventzke.) Dated 7.

"Improvements in electric and automatic sig- apparatus, for use in the block system and for ing level crossings on railway aad tramway E. De Pass. (Communicated by H. Leblanc V. A. Loiseau.) Dated March 8.

"Apparatus for operating fog-bells." W. P. SON. (Communicated by the International Fog- ompany.) Dated March 8.

"Galvanic batteries." G. F. Redfern. Dated 8.

. "Veber-meters or devices for measuring and ring the current flowing through conductors." Brewer. (Communicated by T. A. Edison.) March 9.

. "Improvements in electric lamps, candle , or candles and apparatus connected there- J. A. Berly. Dated March 10.

. "Electric light apparatus." A. A. Common F. Joel. Dated March 10.

. "A rotary hawse pipe for light-ships or other d vessels, for the purpose of keeping submarine ph or telephone cables clear of the cable chains the ship is swinging by tide or force of wind." KSHOTT and H. M. Goodman. Dated March 14.

. "A new or improved system of automatic telegraphy and apparatus and materials to be yed therein." B. J. B. Mills. (Communicated A. Leggo.) Dated March 14.

. "Improvements in voltaic batteries, which im- nents are also applicable to secondary batteries." Johnson. (Communicated by La Société Ano- la Force et la Lumière, Société Générale de ricité.) Dated March 14.

. "Electrical bath apparatus." W. R. Lake. nunicated by B. Barda.) Dated March 14.

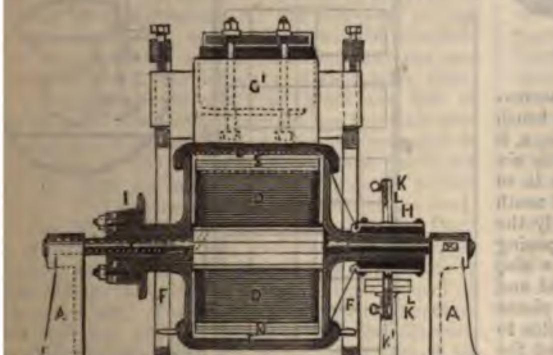


FIG. 1.

. "Telegraphy." S. Pitt. (Communicated by o.) Dated March 15.

. "Improvements in electrical apparatus for tically recording or registering the times of given and received, applicable for use on s and for other registering purposes." R. H. R. Dated March 19.

1232. "Electric lamps." H. E. M. D. C. Upton. Dated March 21.

1235. "A new system of electric light, called the pneumo-electric system." G. A. Tabourin. Dated March 21.

1236. "Improvements in electric lamps, candles, candle holders, and apparatus connected therewith." J. A. Berly. Dated March 21.

1240. "Armatures for dynamo or magneto-electric machines, electric engines, and motors." E. G. Brewer. (Communicated by T. A. Edison.) Dated March 21.

1257. "Laying telegraph wires." S. Pitt. (Communicated by W. B. Espent.) Dated March 22.

1272. "Improvements in the manufacture of cotton-covered wire and in machinery therefor." W. R. Lake. (Communicated by H. Splitdorf.) Dated March 22.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1880.

2893. "Apparatus for generating electric currents." William Buller Fullerton Elphinstone and Charles Wilson Vincent. Dated July 13. 8d. Relates to improvements in the dynamo-electric machine for which letters-patent were obtained bearing date 27th January, 1879, No. 332, the object being to render the action of the machine comparatively steady and uniform, and to enable it to produce, when desired, an alternating current. The first of these results is obtained in part by arranging the coils diagonally upon the armature drum. This arrangement insures that when the drum is rotating the coils will so follow each other that one will enter the field before the immediately preceding coil has left that field. A further improvement tending to this end and providing also for the production of an alternating current is to cause a definite proportion of the induced current to circulate through the electro-magnets. Fig. 1 is a longitudinal central section of the machine; fig. 2 is a transverse section of the same taken in the line 1, 2, of fig. 1. A, A, are standards bolted to the bed plate, B, and carrying a fixed shaft, C. To this shaft

FIG. 2.

are fitted radial plates of soft iron, D, D, constituting a stationary internal magnet. Mounted loosely upon the shaft, C, and surrounding the magnet, D, is a drum, E, constituting an armature. The heads of this drum consist of open discs cast with elongated hubs or sleeves and fitting on to coned shoulders on the shaft, C. The heads are connected to the barrel of the drum

by screws inserted in its periphery or in any other convenient manner. Surrounding the drum are hanks of insulated wire laid diagonally, and so as to cover the periphery of the drum. The way of arranging these hanks and of turning down the terminals of the hanks to the commutator is clearly shown by fig. 3. This armature drum is situate between the side frames, F, F, which are bolted to the bed plate, B, and are secured together by tranverse tie rods. The use of these side frames is to carry the magnets, G, which surround the armature drum and constitute the outside field magnets. These magnets, G, are composed of plates of soft iron having a V-shape in cross section, which shape facilitates the winding on of the insulated wire. The magnets, G, are set radially and concentrically around the armature drum, and are secured to the side frames by transverse bars of wood, G^1, which extend from one side frame to the other. H is the commutator keyed on a sleeve of the armature drum, and I is a band pulley cast with the other sleeve of the drum. Through this pulley rotary motion is imparted to the armature drum for the purpose of setting the machine in action; K is an annular frame supported by pillars, K^1, which stand up from the bed plate. This frame is arranged concentric with the armature drum, and is formed with

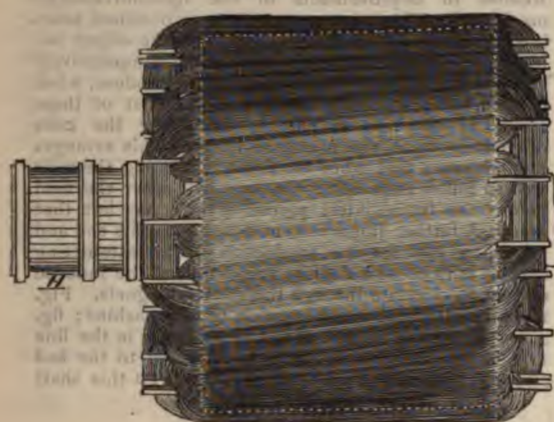


FIG. 3.

a rebate at its inner side to receive a ring, L, correspondingly rebated, which carries the commutator brush holders. By referring to the sectional view, fig. 2, it will be seen that the magnet, D, is formed with six leaves. Upon these leaves the insulated wire is so coiled as to constitute them alternately north and south poles as indicated by the letters, N, S. Similarly the magnets, G, are so arranged as to present opposing poles to the several poles of the magnets, D, as also indicated by the letters, N, S. Both the internal and external magnets are provided with broad pole pieces for the purpose of presenting broad magnetic fields to the coils or hanks of the rotating armature, and the coils of these two sets of magnets are connected together, and to their collecting brushes, by wires in any convenient manner. The inclination of the hanks of the armature with respect to the axis of the drum may vary without material detriment to the object in view so long as the hanks in their revolution follow each other in such manner that a fresh hank will enter the field before the immediately preceding one has left that field. The currents can be made alternating by varying the method of coupling up the commutator brushes.

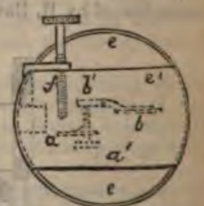
2989. "Electric pile." MICHEL STAVROU AZAPIS and PANAGIOTIS STAVROU 'AZAPIS. Dated July 22. 2d. This invention relates to an electric pile of constant current and great intensity, and is an improvement or modification of the Bunsen and the Daniell pile. The improvement essentially consists in substituting for the acid or acidulated liquid usually employed in the outer vessel of the pile, a solution in distilled water of any salt, but particularly of cyanide of potassium, or of caustic potash, or of sal-ammoniac in the proportion of about 10 parts of salt to 100 of water. Instead of the salts above indicated, the following vegetable substances can be used in the state of infusion, decoction, or otherwise, namely, sulphate of quinine and quassia amara:—For the sulphate of quinine are employed about 3½ grains (216 milligrammes) of quinine for 555 grains (36 grammes) of water; for the quassia amara the same proportion is adopted as for the salts above indicated. The liquid in the inner porous vessel is the same as in the Bunsen and Daniell piles. (*Provisional only.*)

3043. "Plating iron, steel, &c., with nickel, cobalt, and their alloys." F. C. GLASER. (A communication by Theodor Fleitmann, of Iserlohn, Prussia, Germany.) Dated July 24. 2d. Relates to an improvement on a process previously patented, in which the principal condition for success is the complete exclusion of air from the surfaces to be welded. This is effected by wrapping the metals to be united with thin metal sheets, exposing them to the required heat, and uniting them afterwards by the hammer or by rolling, the metal sheets used as wrappers being subsequently removed from the product by chemicals or in any other suitable manner.

3062. "Automatic fire alarms." R. T. BROWN. (A communication from abroad by Frederick Bogen, of

FIG. 1.

FIG. 2.



Valparaiso.) Dated July 24. 6d. Has for its object improvements in automatic fire alarms. For this pur-

pose, together with other instruments, a "detector" is employed. A side view of the detector is shown by fig. 1, and fig. 2 is a plan of the same. It consists of two straight compound blades *a* and *b*, and each blade is composed of two strips of different metals soldered together in such manner that when heated the compound blade will become somewhat curved. These two blades are placed side by side, and parallel the one to the other. At one end they are attached to insulated supports (upon which are the binding screws, *c*, *c*, for holding the ends of the circuit wires), and at the other end one blade is provided with a contact screw, a^1, by which it makes contact with an arm, b^1, provided upon the other blade. Adjusting screws, *d* and d^1, are also provided to press upon the blades near their attachments to the insulated supports for the minute regulation of the contact between the blades at their other ends. One of the compound blades, viz., *a*, is provided with a sheath of paper, but the other, *b*, is left bare. The whole of these parts are contained within a cage, *e*, which serves to protect them from mechanical injury. e^1 is a turn button for closing the end of the cage after the instrument has been adjusted; e^2 is a stem on the side of the cage to enter a socket conveniently placed to hold the instrument. One or more of these detectors is placed in each room or place where protection may be judged to be necessary, and each is connected with a battery so that an electric current continues to flow through the detector so long as the two blades of the instrument continue in metallic contact. In the circuit with each detector there is an electro-magnet, which serves so to increase the resistance of the circuit as to prevent undue waste in the battery, and the magnet also serves to hold an armature, and when at any time the circuit is broken the movement of the armature closes the circuit of an electric bell, this being the instrument by which the alarm is sounded.

City Notes.

Old Broad Street, March 30, 1881.

DIRECT SPANISH TELEGRAPH COMPANY, LIMITED.—The report of the directors for the half-year ending 31st December, 1880, states that the shareholders will no doubt observe with satisfaction that the accounts for the half-year ending 31st December, 1880, show a balance to the credit of profit and loss of £6,962 6s. 3d. The traffic receipts for the half-year are £1,652 14s. in excess of those for the corresponding half-year of 1879. Both cables have continued during the whole six months, and are now, in perfect condition. The underground line to connect the landing of the Bilbao Cable at the Lizard with the Post-Office at Falmouth has been completed in the most satisfactory manner, and the Company's new offices in the Post-Offices Buildings at Falmouth were opened on 12th January last. The accounts for the construction of this line are not yet complete, but the directors expect that the total cost will only slightly exceed the estimate of £2,500. The directors are happy to be able to state that the arrangements they succeeded in making with the French and Spanish Telegraph Administrations for a reduced rate over the Barcelona Cable, which came into force on 1st January last, have considerably increased the net earnings of that cable. After paying the dividend on the preference shares for the half-year there will remain £4,040 16s. 3d., out of which the directors recommend that the arrears of 10s. per share, amounting to £2,921 10s., still due on the preference shares, be paid, and the balance (£1,119 6s. 3d.) added to the reserve fund, which will then amount to £3,197 18s. 8d. The meeting takes place on Thursday March 31st at the Company's offices.

THE WESTERN AND BRAZILIAN TELEGRAPH COMPANY, LIMITED.—The directors have issued their report and the accounts of the Company for the year ended 30th September, 1880. It is stated that the total earnings amounted to £110,933 0s. 9d.; amount returned on royalty account, £3,000; total £113,933 0s. 9d., or an increase of £18,199 6s. 4d., as compared with last year. The ordinary working expenses for the year amounted to £33,179 5s. 8d., as against £31,278 15s 4d.; or an increase of £1,900 10s. 4d. The maintenance for the year amounted to £41,849 2s. 3d., as against £24,270 10s. 7d.; or an increase of £17,578 11s. 8d. The debenture interest for the year amounted to £23,120 19s. 6d., as against £17,258 0s. 11d.; or an increase of £5,862 18s. 7d. The increase of ordinary working expenses is made up mainly of legal charges. The increase of expenditure on maintenance account arises from the fact that two ships had to be employed to get the system into good working order, and afterwards it became necessary to bring the *Norseman* home for repairs, and with a view to her return with more cable. The additional steamer *International* was finally discharged in July last; the heavy payments under this head in Abstract "B" then ceasing. Deducting the above expenses from the revenue there remains a balance of £35,904 12s. 10d., plus return royalty account, £3,000; together £38,904 12s. 10d. The interest on the A, B, and C debentures amounts to £23,120 19s. 6d., leaving a balance of £15,783 13s. 4d. against this has to be placed £3,967 6s. 11d., balance of renewal account brought forward from last year, and £10,300 15s. 9d. rebate on former issue of C debentures, leaving £1,515 10s. 8d. to be carried forward to the current year. The C debentures had to be withdrawn from circulation, and the rebate still standing to debit account, under the advice of the auditor, to be made a special charge against the earnings of the year. It is a source of some satisfaction to the board that the exceptional expenses of the year, amounting in the aggregate to £31,846 14s. 4d., have all been met out of revenue. The insertion of the sheathed cable, as already reported, has considerably improved the working of the line, and during the past year the interruptions have been less frequent. Arrangements are being made for the shipment of the remaining 200 miles of sheathed cable to Brazil, and the directors hope that as this is substituted for the deep sea type, the lines will continue to work with increasing efficiency. The directors regret to state that the competition of the Brazilian Government land lines still continues. The representations of the board conveyed through the secretary, who was sent to Brazil last year, were, however, favourably received, and he succeeded in obtaining the appointment of a special Commission to determine the question. A change of government unfortunately occurred, and the Company's petition was thrown out, but the directors are using every effort to obtain a just and favourable decision. The board can only reiterate their formerly expressed opinion that the best means to meet the competition, and to promote the Company's prosperity, is to keep the lines in an effective state. Since the interim meeting in June last, it has been incumbent upon the board to commence actions for the recovery of large sums of money, which they are advised were improperly expended in the promotion of this Company and the Great Western Telegraph Company. The action is now about to be entered for trial, and is expected to be heard shortly. In the meantime, the matter being *sub judice*, discussion would be undesirable and improper. The directors therefore, acting under the

advice of counsel, have decided to defer, for the present, the holding of the annual meeting. Any information, however, which may be desired as to accounts, &c., will be afforded by the officers of the Company. Sir Edward Watkin, Bart., M.P., and Messrs. Cross, Mendel and Cooke have retired from the direction; the vacancies thus created have been filled by the election of Messrs. Earle, Wood, Goodsall, and Sir Henry Drummond Wolff, G.C.M.G., K.C.B., M.P., the latter gentleman having accepted the position of chairman of the Company. In reference to the cable of the Central American Telegraph Company between Para and Demerara the board have felt that, looking at the large amount standing to the Company's credit in the balance sheet on that account, an effort should be made to insure a thorough examination of the state of the cable with a view to its repair should such examination show this to be advisable. Arrangements have therefore been made for a careful survey of this property. The A and B debentures which matured on 1st August last were duly redeemed, and the shareholders are aware that in March of last year the directors, with their sanction, created £200,000 A debentures, and £250,000 B debentures, redeemable on the 2nd February, 1910, by means of an accumulative sinking fund, and annual drawings, commencing in 1890; power being also given for the issue of a furthur sum of £50,000 B debentures, both classes of debentures bearing 6 per cent. interest. The repairing steamer *Norseman*, completely repaired, furnished with new engines, boilers, &c., left for Brazil in June, fully equipped in every respect. The repairs were effected at a moderate cost, the directors having been able to make the contract at a time when labour and materials were cheap. The ship took out 200 of the 400 miles of cable ordered from the Telegraph Construction Company, and has since been engaged in several repairing expeditions, giving entire satisfaction.

The Eastern Telegraph Company (Limited) have declared a dividend of 2s. 6d. per share, free of income-tax, for the quarter ended December 31, 1880, and one of 3s. per share on the 6 per cent. preference shares, less income-tax, for the quarter ended March 31, 1881. The half-yearly interest on the 6 per cent. debentures will be paid on April 15 next, at the banking-house of Messrs. Glyn, Mills, Currie, and Co.

The Eastern Extension Company give notice of final dividend of 2s. 6d. per share, with bonus of 1s. per share, making 6 per cent. for the year 1880, carrying forward £69,178.

At the meeting of the Hamburg-Heligoland Telegraph Company the dividend for 1880 was fixed at 15 marks or 14s. 7d. per share.

The dividend of the German Union Telegraph Company for the year 1880 will be 30 marks or 10 per cent., 12 marks or 4 per cent. of which was paid in January last.

Under date the 16th March it was notified that the Brest-St. Pierre cable of the Compagnie Française was interrupted close to St. Pierre. The *Pouyer-Quertier* s.s. was to leave at once to effect the necessary repairs.

The *Daily News* of March 21, in recommending reduced tariff for Anglo-American telegrams, states that no fewer than five new competing cables are threatened from various quarters.

A Reuter's telegram of March 15 mentions that the Asiatic Cable Bill passed on that date the second reading in the Dominion House of Commons.

The Globe Telegraph and Trust Company gives notice that interim dividends for quarter ending April 18, 1881, of 3s. per share on the preference shares, being at the rate of 6 per cent. per annum; and 2s. 6d. per share, being at the rate of 4 per cent. per annum, on the ordinary shares.

The following are the final quotations of telegraphs:— Anglo-American, Limited, 57¼-57¾; Ditto, Preferred, 86-87; Ditto, Deferred, 29-29⅛; Black Sea, Limited, ——; Brazilian Submarine, Limited, 10⅛-10⅜; Cuba, Limited, 8¾-9¼; Cuba, Limited, 10 per cent. Preference, 16¼-16¾; Direct Spanish, Limited, 3¾-4¼; Direct Spanish, 10 per cent. Preference, 14-15; Direct United States Cable, Limited, 1877, 10¾-11; Scrip of Debentures, 102-104; Eastern, Limited, 9⅜-9⅝; Eastern 6 per cent. Preference, 12⅛-12½; Eastern, 6 per cent. Debentures, repayable October, 1883, 104-107; Eastern 5 per cent. Debentures, repayable August, 1887, 102-104; Eastern, 5 per cent., repayable Aug., 1899, 102-105; Eastern Extension, Australasian and China, Limited, 10⅛-10⅜; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 108-111; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 104-106; Ditto, registered, repayable 1900, 104-106; Ditto, 5 per cent. Debenture, 1890, 102-104; Eastern and South African, Limited, 5 per cent. Mortgage Debentures, redeemable 1900, 101-103; Ditto, ditto, to bearer, 101-103; German Union Telegraph and Trust, 11-11½; Globe Telegraph and Trust, Limited, 6¼-6⅜; Globe, 6 per cent. Preference, 12⅛-12⅜; Great Northern, 11¼-11⅜; 5 per cent. Debentures, 103-106; Indo-European, Limited, 26½-27½; London Platino-Brazilian, Limited, 6¼-6⅜; Mediterranean Extension, Limited, 2⅛-3; Mediterranean Extension, 8 per cent. Preference, 10-10⅛; Reuter's Limited, 10⅛-11⅛; Submarine, 270-290; Submarine Scrip, 2⅛-2⅜; Submarine Cables Trust, 99-102; United Telephone Company, ——; West Coast of America, Limited, 4⅜-4⅝; West India and Panama, Limited, 1⅛-1¾; Ditto, 6 per cent. First Preference, 6¼-6¾; Ditto, ditto, Second Preference, 5¼-5¾; Western and Brazilian, Limited, 8⅜-8⅝; Ditto, 6 per cent. Debentures "A," 103-107; Ditto, ditto, ditto, "B," 98-102; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 122-127; Ditto, 6 per cent. Sterling Bonds, 101-104; Telegraph Construction and Maintenance, Limited, 31⅜-32; Ditto, 6 per cent. Bonds, 105-108; Ditto, Second Bonus Trust Certificates, 3¾-4; India Rubber Company, 18⅛-19; Ditto, 6 per cent. Debenture, 103-106.

TRAFFIC RECEIPTS.

Name of Company.	February.		Increase or Decrease.
	1881.	1880.	
	£	£	£
Anglo-American.........	49,180	40,830	Inc. 9,350
Brazilian Submarine...	15,104	13,517	Inc. 1,587
Cuba Submarine	2,900	3,140	Dec. 240
Direct Spanish	1,876	...	...
Direct United States...	* 16,390	...	...
Eastern	46,463	44,591	Inc. 1,872
Eastern Extension......	28,021	25,190	Inc. 2,831
Great Northern	16,880	14,160	Inc. 2,620
Indo-European	...	...	...
Submarine	...	...	...
West Coast America...	...	1,300	...
Western and Brazilian	10,169	...	...
West India	4,320	5,488	Dec. 11,68

* Receipt in January, £16,180.

HE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. IX.—No. 197.

PROFESSOR HELMHOLTZ.

HE Society of Telegraph Engineers and of Elecicians, by its *conversazione* held on the 11th inst. t University College, has paid a graceful tribute to ne of the most distinguished physicists of the pre- nt century, and at the same time has given a riking proof of its desire to be no longer con- dered as a Society exclusively devoted to Tele- raphy.

The new title adopted by the Society, although ndered necessary by its determination to lengthen s cords and strengthen its stakes, was hardly a ifficient inauguration of the change, but the step has taken has certainly supplied this omission.

If the Society were purely telegraphic, the re- ption given to Professor Helmholtz would be eaningless, as the great physicist has not directly entified himself with telegraphic science; as electrical society, however, it has done well in ving honour to the distinguished physicist, and likely to bring itself into prominence by ing so.

Professor Herrman Ludwig Ferdinand Helm- ltz, one of the most distinguished natural philo- phers and physiologists of the present century, s born at Potsdam, in August, 1821. After ob- ning his degree as Doctor of Medicine he served a time as a military surgeon, and became, in 49, Extra-ordinary Professor, and in 1852, Ordi- ry Professor of Physiology in the University of inigsberg; in 1855 he become Professor of ysiology in the University of Bonn, and in 1858, ofessor of Physiology in that of Heidelberg. tween 1847 and 1854 he published a most re- irkable and original series of papers on the ation amongst the physical forces, in which he d the foundation of that branch of the general ory of physical energy which shows how elec- city and magnetism as well as heat and motion n be brought under that theory. In 1852 he ntrived a new method of experimenting on the mbination of the colours of the spectrum, by ich all the possible combinations of those colours pairs were exhibited, and various unexpected ts and laws were discovered. He has also in- stigated experimentally the velocity with which sensation and volition are transmitted by the nerves of different animals, the laws of the sensibility of the retina, the development of heat and waste of substance by muscular action, and the mode of vibration of the strings of violins and other musical instruments, making in each case most interesting and valuable additions to our knowledge. The whole of the researches of Professor Helmholtz are marked by rare exactness and care in the observation of details combined with still more rare comprehensiveness and soundness of generalisation, as is evidenced in his "Popular Lectures on Scientific Subjects," which, thanks to Professor Tyndall, have been admirably translated by Dr. Atkinson; by his great work on "The Sensation of Tone as a Physiological Basis for the Theory of Music," translated by Mr. Alexander J. Ellis, F.R.S., and by his essay entitled "Die Erhaltung der Krafte" (the conservation of energy) communicated to the Physical Society of Berlin in 1847, and which brought forth the remark of Dr. Du Bois Raymond, "that it was the production of the first head in Europe since the death of Jacobi."

MOLECULAR ELECTRO-MAGNETIC INDUCTION.

By PROFESSOR D. E. HUGHES, F.R.S.

(Read before the Royal Society, March 17th, 1881.)

(Continued from page 122.)

THE following table shows the influence of a permanent twist, and that the current obtained when the wire was freed from its elastic torsion was in opposition to that which should have been produced by the permanent twist. Thus, a well-softened iron wire, 1 millim. in diameter, giving 60° positive current for a right-handed elastic torsion of 20°, gave after 1°·80 permanent torsion a negative current of 10°.

1	complete permanent	torsion (right-handed)	negative.	10
2	..	..	..	15
3	..	..	..	15
4	..	..	..	16
5	..	..	..	12
6	..	..	..	10
7	..	..	..	5
8	..	..	..	4
9	..	..	..	3
10	..	..	..	3

At this point the fibres of a soft wire commence to separate, and we have no longer a complete single wire, but a helix of separate wires upon a central structure.

If now, instead of passing the current through the coil, I pass it through the wire, and place the telephone upon the coil circuit, I find that I obtain equally as strong tertiary currents upon the coil as in the previous case, although in the first case there was produced longitudinal electro-magnetism in the perpendicular wire by the action of the coil, but in the latter case

none or the most feeble electro-magnetism was produced; yet in these two distinct cases we have a powerful current produced not only upon its own wire, but upon the coil, thus proving that the effects are equally produced both on the wire and coil.

If we desire, however, in these reversible effects to produce in both cases the same electromotive force, we must remember that the tertiary current when reacting upon its own short wire produces a current of great quantity, the coil one of comparative higher intensity. We can, however, easily convert the great quantity of the wire into one of higher tension by passing it through the primary of a small induction coil whose resistance is not greater than one ohm. We can then join our telephone, which may be then one of a high resistance, to the secondary of this induction coil, and by this means, and without changing the resistance of the telephone, receive the same amount of force, either from the iron wire or the coil.

Finding that iron, steel, and all magnetic metals produce a current by a slight twist, if now we replace this wire by one of copper or non-magnetic metals we have no current whatever by an elastic twist, and no effects, except when the wire itself is twisted spirally in helix, and whatever current we may obtain from copper, &c., no matter if from its being in spiral or from not being perpendicular to the axis of the coils, the currents obtained will be invariably secondary and not tertiary. If we replace the copper by an iron wire, and give it a certain fixed torsion, not passing its limit of elasticity, we find that no increase or decrease takes place by long action or time of being under strain. Thus a wire which gave a sonometric force of 50° at the first observation remained perfectly constant for several days until it was again brought to zero by taking off the strain it had received. Thus we may consider that as long as the wire preserves its elasticity, exactly in the same ratio will it preserve the molecular character of its magnetism.

It is not necessary to use a wire to produce these effects; still more powerful currents are generated in bars, ribbons, or sheets of iron; thus, no matter what external form it may possess, it still produces all the effects I have described.

It requires a great many permanent twists in a wire to be able to see any effect from these twists, but if we give to a wire, 1 millim. diameter, forty whole turns (or until its fibres become separated) we find some new effects; we find a small current of 10° in the same direction as it molar twist, and on giving a slight twist (20°) the sonometric value of the sound obtained is 80°, instead of 50°, the real value of a similar untwisted wire; but its explanation will be found by twisting the wire in a contrary direction to its molar twist. We can now approach the zero but never produce a current in the contrary direction, owing to the fact that by the spiral direction, due to the fibrous molar turns, the neutral position of its molecules are no longer parallel with its wire, but parallel with its molar twist, consequently an elastic strain in the latter case can only bring the molecules parallel with its wire, producing no current, and in the first case the angle at which the reaction takes place is greater than before, consequently the increased value of its current.

The measurements of electric force mentioned in this paper are all sonometric on an arbitrary scale. Their absolute value has not yet been obtained, as we do not, at our present stage, require any except comparative measures.* Thus, if each wire is of 1 millim. diameter and 20 centims. long, all render the same stress in the axis of its coil. I find that the following are the sonometric degrees of value:—

	°	
Soft iron	60	Tertiary current.
Hard drum iron	50	" "
Soft steel	45	" "
Hard tempered steel ...	10	" "
Copper, silver, &c. ...	—0	" "
Copper helix, 1 centim. diameter, 20 turns in 20 centims.	45	Secondary currents.
Iron, spiral, ditto ...	45	" "
Steel	45	" "

The tertiary current increases with the diameter of the wire, the ratio of which has not yet been determined; thus an ordinary hard iron wire of 1 millim. diameter, giving 50°, one of 2 millims. diameter gave 100°; and the maximum of force obtained by any degree of torsion is at or near its limit of elasticity, as if in same time we also pass this point, producing a permanent twist the current decreases, as I have already shown in the case of a permanent twist. Thus, the critical point of 1 millim. hard iron wire was 20° of torsion, but in hard steel it was 45°.

Longitudinal strains do not produce any current whatever, but a very slight twist to a wire under a longitudinal strain produces its maximum effects: thus, 20° of torsion being the critical point of iron wire, the same wire, under longitudinal strain, required but from 10° to 15°. It is very difficult, however, to produce a perfect longitudinal strain alone. I have, therefore, only been able to try the effect of longitudinal strain on fine wires, not larger than 1 millim. in diameter, but as in all cases, no effect whatever was produced by longitudinal strain alone, I believe none will be found if absolutely free from torsion. The molecules in a longitudinal strain are equally under an elastic strain as in torsion, but the path of their motion is now parallel with its wire, or the zero of electric inductive effect, but the compound strain composed of longitudinal and transverse, react upon each other, producing the increased effect due to the compound strain.

The sonometer is not only useful for showing the direction of the current and measuring it by the zero method, but it also shows at once if the current measured is secondary or tertiary. If the current is secondary its period of action coincides with that of the sonometer, and a perfect balance, or zero of sound, is at once obtained, and its value in sonometric degrees given, but if the current is tertiary, no zero is possible, and if the value of the tertiary is 60°, we find 60° the nearest approach to zero possible. But by the aid of separate induction coils to convert the secondary into a tertiary, a perfect zero can be obtained if the time of action and its force correspond to that which we wish to measure.

If I place a copper wire in the balance and turn the coils at an angle of 45°, I obtain a current which the sonometer gives a perfect zero at 50°, proving, as already said, that it is secondary. If I now replace the copper by an iron wire, the coil remaining at 45°, I have again exactly the same value for the iron as copper, viz., 50°, and in both cases secondary. Now, it is evident that in the case of the iron wire there was produced at each passage of the current a strong electro-magnet, but this longitudinal magnetism did not either change the character of the current or its value in force.

A most beautiful demonstration of the fact that longitudinal magnetism produces no current, but that molecular magnetism can act equally as well, no matter

* 50° sonometer has the same electromotive force as 0° 10 of a Daniell battery.

direction of the longitudinal magnetism, consists rming an iron wire in a loop, or taking two parallel separate wires, joined electrically at their fixed , the free ends being each connected with the iit, so that the current generated must pass up one and down the adjacent one. On testing this loop, if there are no internal strains, complete silence or nce of current will be found. Now, giving a slight on to one of these wires in a given direction, we say, 50° positive; twisting the parallel wire in a lar direction produces a perfect zero, thus, the cur- of the second must have balanced the positive of irst. If, instead of twisting it in similar directions, twist it in the contrary direction, the sounds are eased in value from 50° positive to 100° positive, ving, in this latter case, not only a twofold increase orce, but that the currents in the iron wires travelled me wire and down the other, notwithstanding that were strongly magnetic by the influence of the coil ne direction, and this experiment also proves that nolar magnetism had no effect, as the currents are lly strong in both directions, and both wires can ble or efface the currents produced in each. If ead of two wires we take four, we can produce a , or a current of 200°, and with twenty wires we e a force of 1,000°, or an electromotive force of two s. We have here a means of multiplying the cts by giving an elastic torsion to each separate , and joining them electrically in tension. If loops formed of one iron and one copper wire, we can in both currents from the iron wire, positive and ative, but none from the copper, its *rôle* is simply of a conductor upon which torsion has no effect.

have already mentioned that internal strains will out tertiary currents, without any external elastic n being put on. In the case of iron wire, these ppear by a few twists in both directions, but in bars or forged iron they are more permanent; ently, portions of these bars have an elastic strain, st other portions are free, for I find a difference at y inch tested: the instrument, however, is so ad- ibly sensitive, and able to point out not only the in, but its direction, that I have no doubt its appli- on to large forged pieces, such as shafts or cannon, ld bring out most interesting results, besides its tical utility; great care is therefore necessary in e experiments that we have a wire free from internal ns, or that we know their value.

agnetising the iron wire by a large steel permanent net has no effect whatever. A hard steel wire thus ed becomes strongly magnetic, but no current is erated, nor has it any influence upon the results ined from molecular movement, as in elastic tor- . A flat wide iron or steel bar shows this better iron wire, as we can here produce transversal, ead of longitudinal, but neither shows any trace of currents produced by molecular magnetism. I e made many experiments with wires and bars thus netised, but as the effect in every case was negative n freed from experimental errors, I will not mention n; but there is one very interesting proof which instrument gives, that longitudinal magnetism first es through its molecular condition before and ng the discharge, or recomposition of its mag- sm. For this purpose, using no battery, I join the tome and telephone to the coil, the wire having no rior circuit. If I strongly magnetise the two ends he wire, I find by rapidly moving the coil that there Faradaic induction of 50° at both poles, but very e or none at the centre of the wire; now fixing the at the centre or neutral point of the wire, and ning intently, no sounds are heard, but the instant ve a slight elastic torsion to the free pole, a rush of electric tertiary induction is heard, whose value is 40°. Again, testing this wire by moving the coil, I find only a remaining magnetism of 10, and upon repeating the experiment of elastic torsion, I find a tertiary of 5; thus we can go on gradually discharging the wire, but its discharge will be found to be a recomposition, and that it first passed through the stage I have mentioned.

Heat has a very great effect upon molecular magnetic effects. On iron it increases the current, but in steel the current is diminished. For experimenting on iron wire, which gave a tertiary current of 50° positive (with a torsion of 20°), upon the application of the flame of a spirit-lamp, the force rapidly increases (care being taken not to approach red heat), until the force is doubled, or 100 positive. The same effects were obtained in either direction, and were not due to a molar twist or thermo-current, as if care had been taken to put on not more than 10° of torsion, the wire came back to zero at once on removal of the torsion. Hard tempered steel, whose value was 10° whilst cold, with a torsion of 45°, became only 1° when heated, but returned (if not too much heated) to 8° when cold. I very much doubted this experiment at first, but on repeating the experiment with steel several times, I found that on heating it I had softened the extreme hard (yellow) temper to that of the well-known blue temper. Now, at blue temper, hot, the value of steel was but 1° to 2°, whilst soft iron of a similar size gave 50° of force cold, and 100° at red heat. Now, as I have already shown that the effects I have described depend on molecular elasticity, it proves at least, as far as iron and steel are concerned, that a comparatively perfect elastic body, such as tempered steel, has but slight molecular elasticity, and that heat reduces it, but that soft iron, having but little molar elasticity, has a molecular elasticity of a very high degree, which is increased by heat.

The objects of the present paper being to bring the experimental facts before the notice of the Royal Society, and not to give a theoretical solution of the phenomena, I will simply add, that if we assume with Poisson, that the paths of the molecules of iron are circles, and that they become ellipses by compression or strain, and also that they are capable of being polarised, it would sufficiently explain the new effects.

Joule has shown that an iron bar is longer and narrower during magnetisation than before, and in the case of the transverse strain, the exterior portions of the wire are under a far greater strain than those near the centre, and as the polarised ellipses are at an angle with the molecules of the central portions of the wire. its polarisation reacts upon them, producing the comparatively strong electric currents I have described.

PERMANENT MOLECULAR TORSION OF CONDUCTING WIRES PRODUCED BY THE PASSAGE OF AN ELECTRIC CURRENT.

By PROFESSOR D. E. HUGHES, F.R.S.

(Read before the Royal Society March 31st.)

In a paper on "Molecular Electro-Magnetic Induction," presented to the Royal Society March 7, 1881, I gave a description of the induction currents produced by the torsion of an iron wire, and the method by which they are rendered evident. The electro-magnetic induction

balance there described is so remarkably sensitive to the slightest internal strain in anywise submitted to it, that I at once perceived that the instrument could not only determine any mechanical strain such as torsion or longitudinal stress, but that it might indicate the nature and cause of internal strains. Upon putting the question to it, does the passage of electricity through a wire produce a change in its structure? the answer came, it does, and that to a very considerable extent; for an iron wire adjusted to perfect zero, and which would remain free from any strain for days, becomes instantaneously changed by the first passage of a current from a single cell of Daniell's battery; the wire has now a permanent twist in a direction coinciding with that of the current, which can be brought again to zero by mechanically untwisting the wire, or undoing that which the passage of electricity has caused. Before describing the new phenomenon, I will state that the only modificatiom required in the apparatus, is a switch or key by means of which the telephone upon the wire circuit is thrown out of this circuit, and the current from a separate battery of two bichromate cells passed through the wire alone, at the same time, care being taken that no current passes through the coil, but that its circuit should remain open during the passage of the electric current through the wire under observation; an extra switch on this circuit provides for this. The reason for not allowing two currents to react upon each other, is to avoid errors of observation which may be due to this cause alone. When, however, we take an observation, the battery is upon the coil and the telephone upon the wire alone; an experiment thus consists of two operations. First, all external communications interrupted, and an electric current passed through the wire; and, second, the electric current taken off the wire, and all ordinary communications restored. As this is done rapidly by means of the switches, very quick observations can be made, or if desired the effects of both currents can be observed at the same instant.

Now, if I place upon the stress bridge a soft iron wire ½ millim. diameter, 25 centims. long, I find, if no previous strain existed in the wire, a perfect zero, and I can make it so either by turning it slightly backwards or forwards, or by heating the wire to a red heat. If I now give a torsion of this wire, I find that its maximum value is with 40° torsion, and that this torsion represents or produces electric currents whose value in sonometric degrees is 50; each degree of torsion up to 40 produces a regular increase, so that once knowing the value of any wire, we can predict from any sonometric readings the value in torsion, or the amount of torsion in the opposite direction it would require to produce a perfect zero.

If now I place this wire at zero, and thus knowing that it is entirely free from strain, I pass an electric current through it, I find that this wire is no longer free from strain, that it now gives out induction currents of the value of 40, and although there is no longer any battery current passing through this wire that the strain is permanent, the outside coil neither increasing or diminishing the internal strain it has received by the passage of an electric current through the wire; upon giving a torsion to the wire in one direction I find the inductive force increase from 40 to 90, but in the other direction it is brought to zero, and the amount of torsion, some 35°, required to bring the wire again to zero represents exactly the twist or strain that had been produced instantaneously by the passage of an electric current. If I repeat the experiment, but reverse the battery current sent through the wire, I find that an opposite twist of exactly the same value as previously, and *that it now* requires an opposite torsion to again bring the wire to zero. It is not necessary, however, to put on an equal opposite torsion on wire to bring the currents to zero, for, as I have shown in my late paper, the sonometer not only allows us to measure the force and indicate its direction, but allows us to oppose an equal electric current of opposite name, thus producing an electrical zero in place of the mechanical one produced by torsion.

Evidently here there has been a sudden change in the structure of the wire, and it is a twist which we can both measure and reproduce. The question at once becomes, has a molar twist been given to the wire such as would be detected by the arm or free end of the wire, or a molecular change leaving no trace upon its external form of what has passed?

It will be found that, notwithstanding that it requires some 40° of torsion to annul the effects of a passage of an electric current, no visible movement nor any tendency of the free end to turn in the direction of the twist it has received can be observed. I believe, however, to have noticed a slight tremor or movement of half a degree, but as I could not always reproduce it, and as it is so slight compared with the 40° of internal twist, I have not taken it into account, for if the wire is firmly fastened at both ends, no molar torsion being possible, except an elastic one, which would instantly spring back to zero, the current on passing produces its full effects of twist and it is permanent. Thus, the molecules have in some extraordinary way re-arranged themselves into a permanent twist, without the slightest external indication of so great a change having taken place. An equally remarkable change takes place in aid of, or against (according to direction of current) an elastic permanent strain. Thus, if I first put the wire under 40° right-handed permanent torsion, I find its value to be 50. Now, passing the positive of battery through its free end, and negative to fixed end, the induction currents rise at once in value to 90; if, now, the negative is momentarily passed through the free end and positive to fixed end the induced currents at once fall to 10, and these effects remain, for on taking off the elastic torsion the wire no longer comes to zero, but has the full twist value produced by the current.

Tempered steel gave only one or two degrees against 50 for soft iron, but supposing this might be due to its molecular rigidity, I carefully brought the wire to zero, and then observed the first contact only. I found, then, that the first contact gave a value of 40, but the second and following only one or two. By bringing the wire back to zero by a momentary touch with a magnet, a continued force of 40, or if constant reversals were used instead of a simple contact, there was constant proof of a similar great molecular change by the passage of a current in steel as well as iron.

I can find no trace of the reaction of the wire upon the magnetism of the earth, as in all positions the same degree of force was obtained if great care is taken that the wire is absolutely free from longitudinal magnetism; there is, however, a slight reaction upon its own return wire if brought within 1 centim. distance of the wire, and this reduces the twist some 10°. The maximum effects are obtained when the return wire is not nearer than 25 centims.; thus, the action is not one produced by a reaction, but by direct action upon its internal structure.

Copper and silver wires so far show no trace of the action. I believe, however, that a similar strain takes place in all conductors, and I have obtained indirectly indications of this fact; in order, however, to verify this, it would require a different method of observation from the one I have described, and I have not yet perfected the apparatus required.

It seemed probable that if I approached a strong permanent magnet to the wire, I should perceive a twist similar to that produced by the passage of a current; but no such effects were observed, but it has a most remarkable effect of instantly bringing to zero a strain produced by the current, and, no matter which pole, the effect was the same. Thus, a strain of 50°, which remains a constant, instantly disappears upon the production of longitudinal magnetism, and I have found this method of reducing an iron wire to zero of strain far more effective than any other method yet tried, such as vibrations, heat, twisting, &c.

It will be seen from this that the molecular arrangement set up by magnetism is very different from that produced by the passage of an electric current. It evidently has a structure of its own, else it would not have instantly destroyed the spiral strain left by the passage of electricity if it had not taken up a new form, as rendered evident in the longitudinal magnetism, which we could at once perceive on the wire. This question, however, belongs to a separate investigation, and I hope the apparatus will aid me later in throwing some new light upon this subject.

Another method of reducing the wire to zero, after the passage of a current, is to keep the wire in a constant state of vibration. It requires in time about one minute to bring it to zero, but if, on the contrary, I set the wire vibrating during the passage of the current, the permanent twist becomes greater and more difficult to reduce to zero.

If a wire which has internal strains is heated to redness, these strains almost entirely disappear, and I can thus reduce by heat a strain which a current had produced; but heat, whilst allowing of greater freedom and motion of its molecules, does not prevent an internal strain being set up, for whilst heat can reduce the wire to zero, after the passage of the current the effects are increased. If, during the time that the wire is at a red heat, the current is passed in the same time, and at the same instant we take off the current and the external heat, the wire when cold will be found to have a higher degree of strain than previously possible with the wire when cold.

We have seen that both mechanical vibrations and heat can reduce the wire to a zero, but its action is very slow, several minutes being required; but the action of electricity in producing a permanent twist is exceedingly quick. I have found that a single contact, whose duration was not more than 0·01 of a second, was equal to that of a prolonged contact of several minutes, and magnetism was equally as quick in reducing this strain to zero. And it is the more remarkable when we consider the very great mechanical force required by torsion of the wire to untwist the strain produced in an instant of time by electricity.

The results I have given are those obtained upon soft iron wires of ½ millim., but I have experimented with different sizes up to 3 millims. diameter. The results with 1 millim. diameter were quite as evident as the ½ millim., but on the 3 millim. wire the strain was reduced to 25° instead of 50°, owing to the extreme rapidity and low electrical resistance compared with my small battery wires. On a telegraph line, the wire of which is almost entirely of iron, there must be a very great strain set up, which, however, would remain a constant, except where reversed currents are used, and in this case a constant movement of the molecules of the wire must be the result.

I believe it to be most important that we should determine, as far as we can by experimental research, the nature of all molecular changes produced by electricity and magnetism, and in this belief I am happy in being able to bring this paper before the Royal Society.

THE ILLUMINATION OF A CIRCULAR AREA.

By PROFESSOR HOFFMANN.

PROBLEM.—At what height h above the centre of a circular area of radius a must a source of light be fixed in order that

1. The illumination of the circumference
2. That of the whole area

shall be a maximum?

First Solution.—Let the source of light be L, the angle which the ray LA leading to any point of the circumference A forms with the surface of the circle ω and J_0, the quantity of light of the ray at the distance $= 1$, then the illumination of the point A of the circumference proportional to the incident quantity of light

$$J_A = J_0 \frac{\sin \omega}{r^2}$$

r denoting the distance LA.

For with an equal reflective power of the area and without regarding the absorption of the medium traversed by the light, the illumination is directly as the sine

of the angle at which the ray falls upon the surface, and indirectly as the square of the distance.

For the above expression, putting LO $= h$, we may write

$$J_A = J_0 \frac{\sin \omega}{r^2} = J_0 \frac{h}{(a^2 + h^2)^{\frac{3}{2}}},$$

and consequently the illumination of the whole circumference of the radius OA $= a$.

$$(1) \quad J = J_0 \frac{2\pi a h}{(a^2 + h^2)^{\frac{3}{2}}}.$$

By the repeated differentiation of this equation we have

$$(2) \begin{cases} \dfrac{dJ}{dh} = 2\pi a J_0 \dfrac{a^2 - 2h^2}{(a^2 + h^2)^{\frac{5}{2}}} \\[2ex] \dfrac{d^2J}{dh^2} = 2\pi a J_0 \dfrac{3h(3a^2 - 2h^2)}{(a^2 + h^2)^{\frac{7}{2}}}. \end{cases} \quad \text{and}$$

Hence it follows that in the first case a maximum exists, and secondly, since $h = \infty$ that it cannot be utilised. This maximum for which $\frac{dJ}{dh} = 0$ appears

when

$$(3) \quad \begin{cases} a^2 - 2h^2 = 0, \\ h = \frac{a}{2}\sqrt{2} = 0{\cdot}7071\,a. \end{cases} \quad \text{or}$$

The source of light must therefore be fixed at a height approximately equal to 0·7; the radius of the circle and the maximum illumination is $\frac{4\pi J_0 \sqrt{3}}{9a}$.

Second Solution.—In order to find the illumination of the entire circular area at the given distance h from the source of light we must consider an infinitely narrow circular ring of the internal radius y and the breadth dy. Its illumination would be

$$2\pi h\, J_0 \frac{y\,dy}{(y^2 + h^2)^{\frac{3}{2}}},$$

and in consequence the illumination of the entire area of the circle.

$$(4) \quad J_1 = 2\pi h\, J_0 \int_0^a \frac{y\,dy}{(y^2 + h^2)^{\frac{3}{2}}}$$
$$= 2\pi\, J_0 \left\{ 1 - \frac{h}{(a^2 + h^2)^{\frac{1}{2}}} \right\}.$$

This would be the illumination of the area when the source of light is perpendicularly above its centre at the distance h.

In order to examine whether at a certain distance of the source of light there is produced a maximum illumination of the area of the circle we assume h in equation (4) as variable, and differentiate. This gives

$$(5) \quad \begin{cases} \dfrac{d J_1}{d h} = -2\pi\, J_0 \dfrac{a^2}{(a^2 + h^2)^{\frac{3}{2}}}, \quad \text{and} \\ \dfrac{d^2 J_1}{d h^2} = 6\pi\, J_0 \dfrac{a^2 h}{(a^2 + h^2)^{\frac{5}{2}}}. \end{cases}$$

There exists therefore in this case no maximum illumination, but a minimum, which is of course reached when $h = \infty$. J_1 is then $= 0$.

Consequently, and in accordance with equation (4), the illumination of the area of the circle will continually increase as the distance of the source of light diminishes. Still equation (4) must not be interpreted to mean that a maximum illumination is reached when $h = 0$; that is, $J_1 = 2\pi J_0$. This case, as well as $h < 0$ is excluded because for each element of the area the angle of irradiation $\omega = 0$, and consequently as $\sin 0 = 0$ the incident quantity of light $= 0$.—*Electrotechnische Zeitschrift*, Vol. ii. Part 3.

THE telephonic exchange system in Cleveland, Ohio, and several other places, contemplates a tariff based on single messages, a "message" consisting of a conversation through the exchange occupying five minutes or less time. The charge is ten cents per "message," beside which tickets good for one message each are sold at the rate of 7 dols. for packages of 100.—*The Operator.*

MAICHE'S BATTERY.

THE inventor of this entirely original form of battery, of which we give an illustration, has endeavoured to fulfil all the conditions necessary to make his battery work for an indefinite period, and this ideal result is obtained—thanks to the means of depolarisation which he employs.

A porous vase, pierced with large holes, is fixed to an ebonite cover, which closes an earthenware vase filled with retort carbon, broken in pieces and platinised. The porous vase is traversed by an ebonite tube supporting a small porcelain cup, in which is placed a small quantity of mercury and two small pieces of zinc. A platinum wire, connected to a terminal fixed on the cover, dips into the mercury, and establishes a good contact with the zinc.

Another platinum wire connects a second terminal with the carbon fragments placed in the porous vase. The contacts are thus completely assured. The zinc is not attacked, except when the circuit of the battery is closed; it is plunged entirely in the liquid, consequently it is entirely used up without any loss.

Under the influence of the platinised carbon, the hydrogen of the water, which tends to polarise the carbon, combines with the oxygen of the air. That this novel effect, sought for in vain for a long time, can take place, the carbon should only be partially immersed in the water; the rest becomes wetted by capillary action, and presents a considerable surface to the air.

The water produced by the combination of the hydrogen and the oxygen contributes, to a certain degree, to replace that which passes off by evaporation, and which the cover keeps from being lost.

The electromotive force of this battery is about

1·250 volts.; but it is necessary to work it through an external resistance of about 3 kilometres of ordinary telegraph wire in order that it may work well. The exciting liquid may be water saturated with sal-ammoniac, or acidulated by sulphuric acid, or the bisulphate of soda, in the proportion of 10 to 1.

An element working a bell about 100 times a day would not require to be looked after for a very long time, and, in this case, it would only be the zinc that would require replacing, as the platinised carbon preserves indefinitely its catalytic properties.

The Maiche battery is particularly well adapted for electric bells. Maintenance not being required, its fitness and the care taken in its whole construction, makes it the most perfect bit of apparatus of its kind.—*L'Electricité.*

THE HISSING OF THE VOLTAIC ARC.

By ALFRED NIAUDET.

THE researches of M. Edlund have shown that the voltaic arc has a double resistance, not only an ordinary one as a conductor, but also an active resistance like the polarisation in a voltameter or the electromotive force of the induction of an electro-magnetic motor.

It is extremely difficult to measure the two quantities separately, but, on the contrary, it is easy to measure the *equivalent resistance of the arc;* that is to say, to determine a resistance in ohms which is substituted in the place of the arc and which does not change the strength of the current. On the other hand, thanks to the absolute galvanometer of M. Deprez for measuring electromotive forces, it is very easy to measure the difference of potential between the two carbon electrodes.

The employment of this galvanometer has revealed a curious fact; viz., that the potential is much greater when the arc is silent than when it hisses. The difference is sometimes as much as 10 volts. The needle of the galvanometer can be seen to move sharply and without oscillations from one deflection to the other. If the eye and ear are both kept attentive the noise in the arc can be detected, and a corresponding movement of the galvanometer needle be observed.

The values of the current strengths naturally vary inversely as the potentials of the arc, and if a Deprez galvanometer is placed in the circuit its movements will indicate in webers the value of this element.

The observations which we have made show that the difficulty of measuring the actual resistance of the arc and its electromotive force is much greater than is generally supposed.

THOMAS A. EDISON has removed from Menlo Park to New York with his family and all but one of his assistants, and is now living at No. 65, Fifth Avenue. The offices of the Edison Luminating Company of New York, the Edison Electric Light Company of Great Britain and Europe, and the Edison Electric Railway will also be in the building.

TELEGRAPHIC APPARATUS IN USE IN THE BRITISH POSTAL TELEGRAPH DEPARTMENT.

XXXI.

THE QUADRUPLEX SYSTEM.

THE introduction of the quadruplex system into the Postal Telegraph Department has proved so successful that at the present time nearly a dozen circuits are worked on the principle, and no more difficulty is found in working the apparatus than is experienced in ordinary duplex transmission. This is in a great measure owing to the care which has been exercised in the construction of the instruments. Although the original American patterns have been principally adhered to, several small improvements have been introduced in the apparatus which have proved of greater value than their apparent insignificance might warrant; but it is on small improvements often that the thorough good working of a circuit depends.

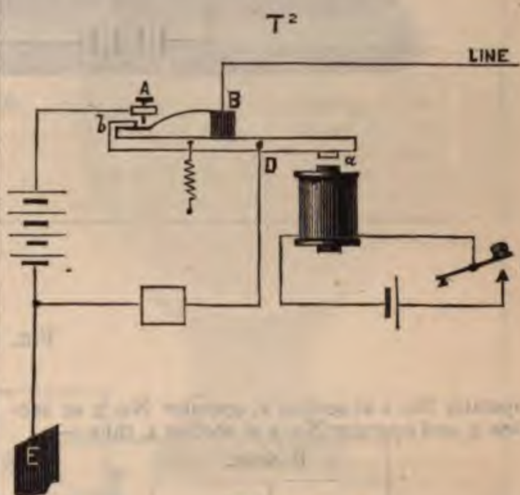


FIG. 125.

In the quadruplex system as at present worked, at each station there are two relays, the one working by change of current strength only and the other by change of direction, so that the two can be worked together if we alter the strength of the currents without affecting their direction, or change their direction without affecting their strength. This is accomplished by combining double current and single current working in such a way that one relay is worked by the one system of currents, and the other relay by the other system of currents. A current is constantly flowing through the line: a change in its direction operates one relay; a change in its strength operates the other relay. The first relay is a simple polarised one, and responds to the reversal of the currents, whatever their strengths; the second relay in the original form of apparatus was a neutral or non-polarised relay, adjusted by an antagonistic spring, so as to fail to respond to the reversed currents unless the latter were of consider-

able strength. Thus the two relays were perfectly independent of each other. They actuated separate sounders, and each was under the control of its own receiving operator, who could thus adjust for himself.

In actual practice difficulties were found in working the neutral relay, especially on long circuits, as the reversal of the current produced breaks or "kicks." This defect, however, Mr. Gerritt Smith remedied in 1876 by introducing the "compound relay," which is now in use. The two sets of apparatus, one at each station, are duplexed in the ordinary manner.

For convenience in working, a tablo or counter is divided into four sections, and the apparatus is so arranged that operator No. 1 sits at section 1, operator No. 2 at section 2, operator No. 3 at section 3, and operator No. 4 at section 4, thus:—

B SIDE.

Section 4	Section 2
Section 1	Section 3

A SIDE.

The sections 1 and 3 are known as the A side, and the sections 2 and 4 as the B side of the apparatus.

There is the same arrangement at both stations.

Section 1 of one station sends to section 3 of the other, and similarly section 2 sends to section 4.

At each station there are two keys for the ordinary transmission purposes, the one key being a double current one, sending reversals, and the other a single current one, which increases the strength of the reversals sent out by the first key.

As it is a matter of importance that the reversals and increases shall take place sharply and distinctly, the hand-worked keys do not directly manipulate the currents, but merely actuate a "pole reverser" and a "current increaser" by means of local batteries called into action by the keys.

The arrangement of the "current increaser" is shown by fig. 125. It is known as Stearn's duplex transmitter, being generally used in America for duplex working. The line is shown to earth through B and D, but when the armature, *a*, is attracted by the closing of the local circuit (by the depression of key, K), contact between B and E is broken at *b*, while at the same moment contact between A and B is made, and a current from the battery is sent to line. If a second battery be in circuit with the line, then it

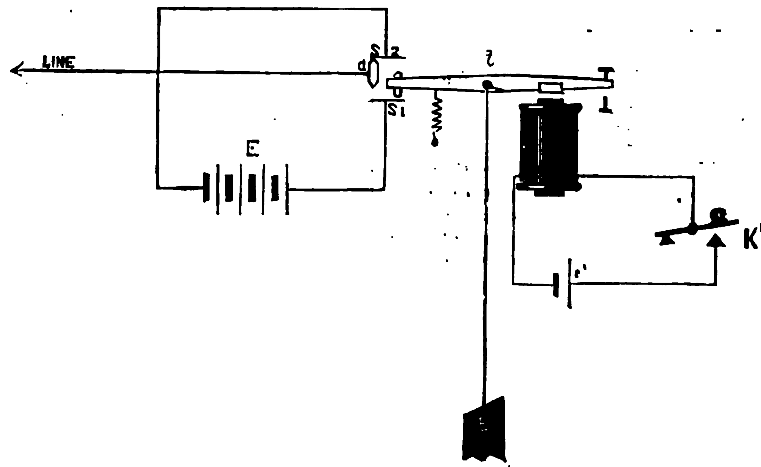


FIG. 129.

is evident that under ordinary conditions a current will continually flow to line from this battery; but if the transmitter be worked, then the battery first referred to will be added to the second battery, and the current flowing to line will consequently be increased.

If wires from the two batteries and the transmitter be passed through a reversing apparatus before passing to line and earth, then this apparatus can reverse the currents, whether they be of their normal strength or be increased.

The general form of the "current increaser" is shown by fig. 126. The two right-hand terminals are connected to the electro-magnet, the left-hand terminal is connected to the contact screw, A, the second terminal to the spring, *b*, and the third terminal to the lever, D.

The general form of the current reverser or "pole changer" is similar to fig. 126, but the arrangement of contacts is of course different, and is shown in general principle by fig. 129.

In the apparatus as shown, a zinc or negative current is going to line through s^2 and *a* from battery E, the copper pole being to earth through s^1 and *t*. When the key, K^1, is depressed, and the local circuit of e^1 completed, the lever, *t*, which is in connection with earth, is brought in contact with s^2, and line, or *a*, with s^1, which causes a

FIG. 126.

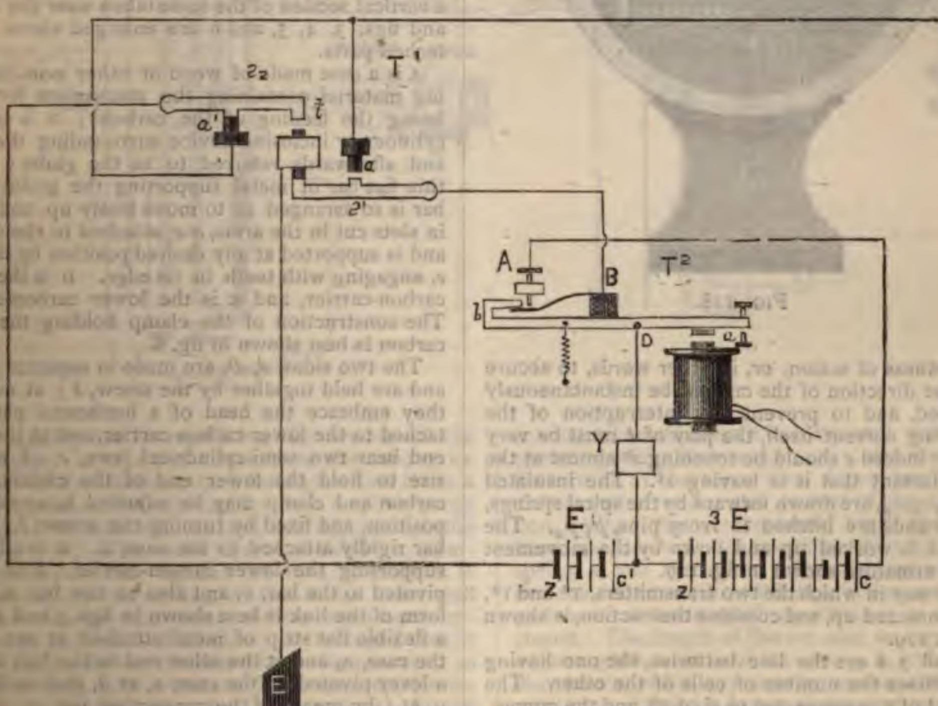


FIG. 127.

reversal or a copper or positive current to flow to line.

The working part of this transmitter, as reconstructed from the original American pattern, is shown by fig. 128.

t is an end view of the lever of the transmitter which is in connection with earth; s^1 and s^2 are two insulated contact levers in connection with the zinc and copper poles of the line battery respectively. The play of these levers is limited by the contact screws, *a* and a^1, which are in contact with the line through the pillar, *d*, that supports them. This figure, it is evident, shows a zinc current going to line; but if the lever, *t*, were raised, then contact between s^2 and a^1 would be broken, and zinc would be put to earth through *t*. On the other hand, contact between *t* and s^1 would be broken, but contact between s^1 and *a* would be made, and copper be put to line. To obtain rapidity and

FIG. 128.

promptness of action, or, in other words, to secure that the direction of the current be instantaneously reversed, and to prevent any interruption of the incoming current itself, the play of *t* must be very small: indeed *t* should be touching s^2 almost at the same instant that it is leaving s^1. The insulated levers, s_1, s_2, are drawn forward by the spiral springs, whose ends are hitched to ivory pins, p_1 p_2. The lever, *t*, is worked up and down by the movement of the armature shown in fig. 129.

The way in which the two transmitters, T^1 and T^2, are connected up, and combine their action, is shown by fig. 129.

E and 3 E are the line batteries, the one having three times the number of cells of the other. The zinc, Z^1, of E is connected to s^2 of T^1, and the copper, *c*, of 3 E to A of T^2. The zinc of 3 E and copper of E pass through a resistance, Y (which is the same as the resistance of 3 E, so that the total resistance of the circuit may not be altered by the working of the apparatus) to lever D of T^2. When everything is quiet, zinc of E is connected to line through *s* and a^1 of T^1, and copper of E makes earth through D, *b*, B of T^2, and s^1, *t* of T^1, whilst copper of 3 E is insulated at A of T^2. Thus a positive current of normal strength flows to line.

When T^1 is worked alone, the current of E is simply reversed by raising *t*, or putting s^2 to earth, and s^1 to line. When T^2 is worked alone, s^1 of T^1, which is in connection with earth, is transferred, by means of B of T^2, from D to A, and the strength of the current going to line increases from E to 4 E. Hence the operation of T^2 is just the same as transferring Y from c^1 to *c*.

When both T^1 and T^2 work together, then Z of E is put to earth through *t*, and C to line through A and B of T^2 and s^1 and *a* of T^1; and a reverse current of 4 E is sent. Thus the effect of the working of T^1 is to reverse the current of E, and that of T^2 is to strengthen the current from E to 4 E, in whatever direction it flows.

NEW ELECTRIC LAMPS.

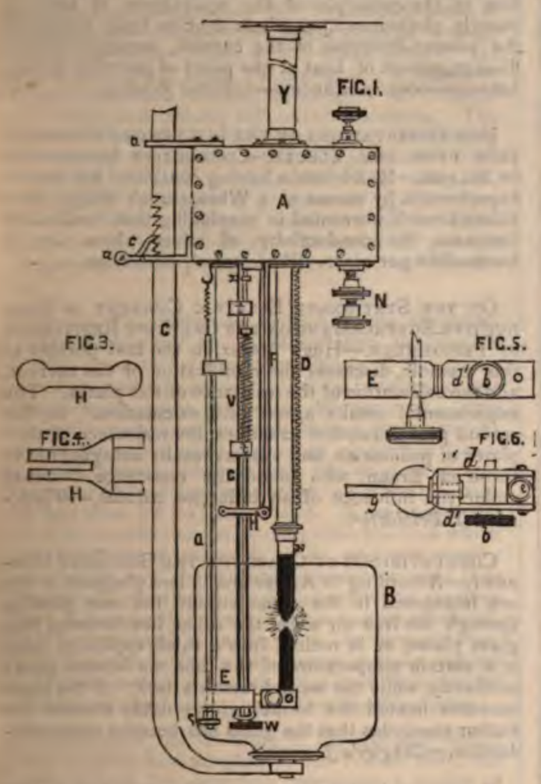
MAXIM'S ARC LAMP.

THIS lamp, the invention of Mr. Hiram Stevens Maxim, of New York, is constructed as follows:—Fig. 1 is a side elevation of the apparatus, fig. 2 is a vertical section of the same taken near the centre, and figs. 3, 4, 5, and 6 are enlarged views of detached parts.

A is a case made of wood or other non-conducting material containing the mechanism for regulating the feeding of the carbons; B is a glass cylinder or inclosing device surrounding the focus, and afterwards referred to as the globe; C is a thin flat bar of metal supporting the globe. This bar is so arranged as to move freely up and down in slots cut in the arms, *a a*, attached to the case, A, and is supported at any desired position by the dog, *c*, engaging with teeth in its edge. D is the upper carbon-carrier, and E is the lower carbon-carrier. The construction of the clamp holding the lower carbon is best shown in fig. 6.

The two sides, *d*, d^1, are made in separate pieces, and are held together by the screw, *b*; at one end they embrace the head of a horizontal pin, *g*, attached to the lower carbon-carrier, and at the other end bear two semi-cylindrical jaws, *e*, of suitable size to hold the lower end of the carbon. The carbon and clamp may be adjusted to any desired position, and fixed by turning the screw, *b*. F is a bar rigidly attached to the case, A. G is a flat bar supporting the lower carbon-carrier. H is a link pivoted to the bar, F, and also to the bar, G. The form of the link is best shown in figs. 3 and 4. I is a flexible flat strip of metal attached at one end to the case, A, and at the other end to the bar, G. J is a lever pivoted to the case, A, at *h*, and to the bar, G, at *j*, by means of the connecting rod, K. L is an axial magnet placed in the lamp-circuit, and M is its core. The upper end of the core passes through and is firmly attached to the head of an inverted cylindrical box, *q*, which fits over the upper head

of the helix, and acts as a dash-pot or controlling chamber for preventing sudden movements of the regulating mechanism. The end of the lever, J, works in a recess, *k*, in the side of the core, M. N is an adjusting screw for limiting the downward movement of the core, M. O is a train of gearing working in a rack, P, on the side of the upper carbon-carrier, and controlling its downward movement. A detent, *m*, upon the lever, J, is so arranged as to come into contact with a star-wheel upon the most rapidly moving shaft of the gearing when the lever is depressed. Q is a rod passing through the lower carbon-carrier, and suspended from the case, A, by means of the spring, R. S is

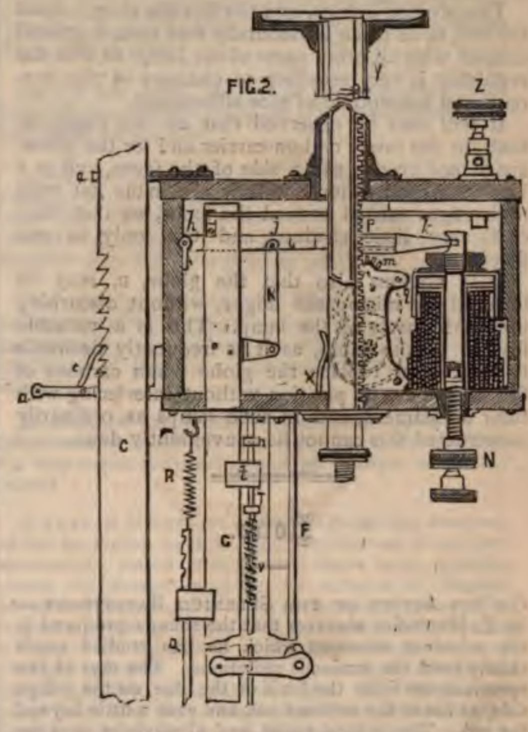


an adjusting nut for regulating the tension of the spring, R. T is a rod attached to the bar, G, by means of the brackets, *t*, *t*', through which it has a free movement longitudinally. V is a spiral spring attached to the rod, T, and bearing against the bracket, *t*'. The rod, T, has a shoulder, *x*, so arranged as to bear against the case, A, when it is thrust up by the spring, V, and at its lower end passes through the lower carbon-carrier and terminates in a forked head, W, so arranged that it may be made to straddle the carbon-carrier, as shown in fig. 5, or when turned a quarter of a revolution, to stand upon its lower surface. In the former position the shoulder, *x*, bears against the lower surface of the case, and in the latter it is drawn down away from it.

The lamp is suspended by means of the tubular support, Y, inclosing the upper carbon-carrier, and the current is admitted to the upper carbon-carrier through a terminal (not shown in the figs.) electrically connected with the spring, X, and to the lower carbon-carrier through the terminal, Z, and spring, I.

The operation of this lamp is as follows :—

The forked head, W, is drawn down and turned around until its legs stand upon the lower surface of the carbon-carrier, E, when the spring, R, raises the bar, G, and lever, J, until the detent, *m*, is raised from the escapement-wheel of the gearing, O. The upper carbon-carrier descends by its own weight until the points of the carbons come into



contact, when the circuit is completed, and a strong current passing excites the coil, L, and draws down its core, M, at the same time depressing the lower carbon and arresting the descent of the upper carbon. When the arc becomes long, the coil, L, becomes too weak to overcome the tension of the spring, R, and the lower carbon is gradually raised and the detent, *m*, is withdrawn, allowing the upper carbon to descend until equilibrium is again restored. The length of the arc may be regulated by adjusting the tension of the spring, R, and the lamp may be stopped at any time by turning the head, W, until it straddles the lower carbon-carrier, E, when the spring, V, obtaining a bearing point against the case, A, at the shoulder, *x*, overcomes the tension of the spring, R, and keeps the lower carbon depressed.

It will be observed that the weight of the upper or positive carbon has no influence upon the operation of the regulating device, which is a material advantage, as the negative electrode is consumed only half as rapidly as the positive one. Where the spring regulating the length of the arc has to support the upper carbon, as in lamps of the ordinary form, it is frequently necessary to re-adjust its tension during the burning of a pencil of considerable length, on account of the diminution of its load, but this difficulty is greatly reduced by applying the adjusting device to the negative carbon. At the same time the arrangement above described secures all the advantages of having the regulating mechanism above the focus, where it does not obstruct the light.

The pivoted link, H, and the flexible strip, I, hold the bar, G, in place horizontally free from frictional contact with all other parts of the lamp, so that the regulator is very sensitive to changes in the current, and susceptible of nice adjustment.

It will also be observed that all the supports, both for the lower carbon-carrier and for the globe, are placed on the same side of the focus, and in a line with each other, and they are made flat with their edges turned toward the focus, so that they cast very little shadow, and that only in one direction.

It is obvious also that the globe, B, may be lowered by raising the dog, *c*, without disturbing the other parts of the lamp. This is a valuable feature of the lamp, as it is frequently desirable to remove or replace the globe when carbons of full length are in position without interfering with their adjustment, and in such lamps as ordinarily constructed this cannot be conveniently done.

Notes.

On the Action of the Selenium Radiophone.—M. E. Mercadier observes that the sounds produced in the selenium receivers which he has studied result chiefly from the luminous radiations. The rays of the spectrum act from the limit of the blue, on the indigo side, as far as the extreme red, and even a little beyond the red. The indigo, violet, and ultra-violet rays are without perceptible action in the conditions under which he has experimented. The maximum effect is always produced in the yellow portion of the spectrum. Radiophones with glass tube-receivers containing air, in contact with a smoked surface, give a different result, the action being principally thermic.—*Comptes Rendus.*

Les Mondes proposes to apply the photophone to the study of the *aurora borealis.*

On the Galvanic Polarisation produced by Metallic Deposits.—D. Macaluso.—The polarisation of copper, employed as negative electrode in a solution of sulphate of zinc, is never null, as Lippmann believes, in cases where the solution contains traces of a salt of copper, and that the deposit of zinc is exceedingly slight and invisible. On the contrary, it has a value which may differ much, and which is so much the greater the smaller the quantity of a copper-salt contained in the solution, and the less the time which has passed from the moment when the polarising current was interrupted.—*Gassetta Chimica Italiana.*

On the Electromotive Force of the Voltaic Arc.—M. F. P. Le Roux.—When an electric flux is established between two conductors of the same nature by means of a gaseous medium, which is commonly the vapour thrown off by their substance, the inequality of temperature of those portions of the conductors which are contiguous to such a medium appears to be a general fact. It seems not less probable that the extremity by which the positive electricity arrives, possesses the higher temperature. This is observed in a remarkable degree in the production of the voltaic arc between two carbons, by means of a current of constant direction. The idea of ascribing to this phenomenon a thermo-electric origin is not novel. According to the application of the principle of the equivalence of heat to electric phenomena, an electromotive force acting in the inverse direction of the current, corresponds to a disengagement of heat at the point of junction of two heterogeneous substances.—*Comptes Rendus.*

New Observations on the Influence of Irradiation upon the Electro-Conductive Resistance of Silver.—R. Börnstein having continued his former experiments, by means of a Wheatstone's bridge, considers himself warranted in concluding that irradiation increases the conductivity of silver plates by 1½ hundredths per cent.—*Wiedemann's Beiblätter.*

On the Stationary Electric Current in Conductive Surfaces, and on the Galvanic Resistance of Psilomelan.—Hugo Meyer, in the first portion of this memoir, discusses the ramification of the current, and the calculation of the resistance of flat plates. The experimental results agree with calculation. In the second part the author examines the resistance of thin plates of psilomelan, and obtains results antagonistic to those of Braun, who found the resistance decrease under the influence of an induction current.—*Wiedemann's Beiblätter.*

Conductibility of Glass for the Galvanic Current.—According to A. Sewarz, if two platinum wires are interposed in the same circuit, the one passing through the free air while the other lies between two glass plates, or is melted into a thick capillary tube, at a certain temperature of the tube the former glows brilliantly, while the second remains dark. If the glass becomes heated the former grows dark, whence the author concludes that the glass has become more conductive.—*Dingler's Journal.*

Magnetic Action upon the Fluorescent Light produced by the Negative Discharge in an Exhausted Space.—K. Domalip.—If we take a well-exhausted cylindrical tube, with rectilinear electrodes placed in its axis, the fluorescent light formed by the cathodic rays consists, as is well known, of a green cylinder bounded by a circle. This circle undergoes transpositions if a magnet is allowed to act upon the discharge. Domalip shows that these, whether in simple or complicated cases, may be explained by the following hypothesis:—The cathodic rays, emanating from the negative electrode, pass on in a straight direction, and the current moves from the anode to the sides of the cathodic space, and from thence to the negative electrode. The magnet acts upon these currents according to Ampère's rule.—*Wiener Berichte.*

Patent Law Amendment Bill.—At a meeting of inventors, patentees, and others, held on the 25th ult.,

Professor Fleming Jenkin in the chair, resolutions were adopted, along with a memorial to the Board of Trade and law officers of the crown, cordially approving of the general features of Mr. Anderson's Patent Law Amendment Bill, and especially of the proposals; first, for provision for the appointment of three paid commissioners to manage the business of the patent offices; second, for providing for the present excessive stamp duties payable on the obtaining of patents; third, deferring the payment of periodical taxes until later periods, and reducing their amounts; fourth, extending the duration of patents to 21 years; and fifth, admitting of subsequent improvements on patented inventions being protected on payment of one half the stamp duties levied on the original patents.—*Building Times.*

Effect of Temperature upon the Electrical Resistance of Selenium.—Mr. Shelford Bidwell, in the *Philosophical Magazine* for April, gives an account of some experiments made on the above subject. He says:—"The room being 14° centigrade, a selenium cell was immersed in turpentine at 8° C. There was a great and sudden fall in the resistance. The temperature was then gradually raised. In passing from 8° to 24° the resistance steadily increased; from 24° upwards it rapidly diminished. For this cell, therefore, the resistance is greatest at 24° C. Five other cells were afterwards submitted to the same operation, and their resistance was found to be greatest at temperatures of 23°, 14°, 30°, 25°, and 22° respectively."

Electric Transmission of Force for Working Cranes.—According to E. Hospitalier, the use of hydraulic pressure for the transmission of the power required in working cranes in docks, involves a loss which, in some cases, may reach 88 per cent. This evil is entirely obviated, in addition to a great simplification of the entire plant, by means of electric transmission of power, which enables the original steam-power to be fully utilised even when the crane is raising much less than its maximum load. If we reduce the loading of a crane the electro-magnetic machine which drives it will have less work to do, and will revolve more rapidly, and the stronger counter-currents thus produced will react upon the dynamo-electric machine in such a manner that there is a less current produced, and a less demand is made upon the steam-power. The only question is, how the current is to be divided into several unequal branches capable of being varied in strength at any moment.—*La Lumière Electrique.*

M. Duchemin, the inventor of the compass with a circular magnet, now adopted in the French navy, has recently devised, for correcting compasses, a system of magnetic compensators. In place of the straight magnetic bars generally employed he uses magnets of an annular form. If we magnetise a steel ring, it may have two poles at opposite extremities of a given diameter and two neutral lines. Such rings—round, oval, or of any other form, and with or without interruption of continuity—may be utilised for the correction of a compass, by being placed either on the bridge of the vessel or in the binnacle.—*Revue Industrielle.*

Dangerous Lightning Conductor.—A lightning conductor was put up at a temporary railway station at Hanover. The connection led to the platform, and an iron bench was fixed so that any unsuspecting traveller might touch the copper conductor.

Galvanic Gilding.—M. Rod gives the composition of a bath to be used at temperatures from 50 to 80° C. It consists of 60 parts crystalline phosphate of soda, 10 parts bisulphate of soda, 1 part cyanide of sodium, 2½ parts chloride of gold, and 1,000 distilled water. In order to prepare the bath the water is divided into three portions of 700, 150, and 150 respectively. The phosphate of soda is dissolved in the first lot, the chloride of gold in the second, and the other ingredients in the third. The two first portions are gradually mixed together, and the third is then slowly added. A platinum plate is used as anode.—*Le Monde de la Science.*

The firm of Biloret and Mora (of the Boulevard Richard Lenoir, Paris), well known for their excellent Leclanché cells and their zinc rods of high purity, have constructed a new revolving contact for their dynamo-electric machines, of the form of a rotatory brush. Besides diminishing the wear and tear of the copper brushes, this arrangement is said to improve the performance of the machine by 25 per cent.—*Zeitschrift Angw. Electricität.*

Edison has made the "quite new discovery" that large dynamo-electric machines are more advantageous than small ones.—*Ibid.*

According to *Les Mondes*, the ship *Oxus* was exposed to a most violent thunderstorm in the Chinese seas. The circular compass of Duchemin perfectly resisted the effects of the lightning, though straight magnetic bars had their polarity modified.

The same journal states that M. Tommasi has made an improvement in duplex telegraphy, by which the apparatus is protected from the influence of the varying resistance of the line. The arrangements are not described.

M. Maiche has greatly increased the power of his telephones by modifying the transmitters. He employs "a very ingenious combination of multiple contacts." —*Ibid.*

A Feat in Nickel-plating.—The plating company of the Berlopton Lane Works, Stockton-on-Tees, have successfully plated with nickel three large cylinder covers for marine engines, on account of Messrs. Maudslay, Son, and Field, the eminent engineers. The largest cover weighs nearly 1¾ tons, and is 6 ft. 6 in. in diameter. It was plated in the large nickel bath, and polished all over successfully by one of Fenwick's patent portable polishing machines. The same company have also just nickel-plated the whole of the bright parts of Sir James Ramsden's yacht engines, built by the well-known firm, the Barrow Shipbuilding Company (Limited), also, some locomotive domes and safety-valve covers.—*Railway News.*

The Consolidated Telephone Construction and Maintenance Company (Limited), is the title of a new company, intended to harmonise the hitherto conflicting interests of the United Telephone Company and the Gower-Bell Telephone Company. The capital is to be £300,000, in £1 shares, of which the first issue is to be £200,000.

A company, entitled the Electric Light and Power Generator Company (Limited), has been formed in London, with a capital of £150,000, in £1 shares. Mr. John Rapieff and Mons. Lontin, the eminent electricians, are associated with this enterprise. We believe the capital was promptly subscribed.

Mr. R. S. Rhodes, of Chicago, the inventor of the audiphone, has lately visited Paris, where M. Eugene

Pereire is giving his invention a trial in the Pereire Institution for the Deaf and Dumb. Through the influence of the late Sir Charles Reed a similar experiment is being made in connection with the schools of the London School Board. Mr. Rhodes is now on a visit to the Deaf and Dumb Institution at Manchester, where great interest is also taken in the audiphone.

A WRITER in the *North American Review* strongly advocates the purchase of the telegraphic system of the United States by the Government. It appears that powers for that purpose were conferred by an Act of Congress in 1866, the value to be ascertained by the appraisement of five disinterested persons, to be chosen as directed. The present "telegraph monopoly" is represented as injurious to commerce. The ordinary message restricted to ten words costs on an average over 38 cents—equal to 1s. 7d. At the close of last year there were 170,103 miles of line, or between seven and eight times more than in Great Britain, and upwards of 33 millions of messages were sent during the year. By degrees the entire system has, with trifling exceptions, come into the hands of the Western Union Company. The total sum actually expended in plant and stock and other things is estimated as not more than fifteen millions of dollars; but the profits for ten years have averaged over 8½ per cent. on a nominal capital of 41 millions. The company, says the writer not only enjoys a monopoly of the business of sending messages, but also a monopoly of commercial intelligence.

COLONEL PARIS, the head of the Paris fire brigade, has concluded his report on the destruction of the Printemps Establishment by proposing that large warehouses be compelled to light by electricity.—*Nature.*

THE Council of the Royal Society have made their selection of future Fellows for the current session. At the annual meeting of the Society, on June 2, the following candidates will be proposed for election:—Professor W. E. Ayrton, Mr. H. W. Bates, Dr. J. Syer Bristowe, Mr. W. H. M. Christie, Professor G. Dickie, Mr. A. B. Kempe, Professor A. Macalister, Professor H. McLeod, Mr. J. A. Phillips, Mr. W. H. Preece, Mr. B. Samuelson, Mr. B. B. Stoney, Dr. Ramsay H. Traquair, Rev. W. H. Watson, and Dr. C. R. A. Wright.

THE EDISON LIGHT IN NEW YORK.—The Mayor of New York has vetoed the ordinance permitting the Edison Electric Illuminating Company to lay tubes in the streets, on the ground that no adequate provision is made for a suitable return to the city treasury for a valuable privilege.

THE trial trip on the electric railway at Berlin has been successfully inaugurated. It is said that considerable difficulties have been experienced in consequence of the leakage which took place from the conductors in wet weather, which has rendered necessary a rearrangement of the method of insulating the same.

ELECTRIC LIGHT AT BRIGHTON.—In view of the experimental street-lighting by electricity in the City of London, some interest attaches to a report made yesterday to the Brighton Town Council by their surveyor (Mr. Lockwood), relative to the recent lighting by Siemens' system of electricity of a portion of the Marine Parade. Originally four lamps (each of 2,000 candle-power) were used at intervals of about seventy yards, but at this distance the light was more powerful than necessary under any circumstances; but when the distances were increased to 133, 154, and 190 yards, and the lanterns inclosing the lights filled with ground instead of plain glass, there was a marked improvement, the light being softer and more agreeable, yet still powerful enough to throw a distinct shadow at 200 yards. The Madeira Road, which was about 80 feet below the lanterns (running parallel with the parade), the beach, and the foreshore were "brilliantly illuminated" down to low-water mark; and, if similar lighting were employed along the whole of the sea-frontage, the esplanades could be used as well by night as by day. No estimate is given of the relative cost of gas and electricity; but some idea of the respective illuminating powers is furnished by the statement that 20 electric lamps (which, if placed 200 yards apart, would illuminate the whole of the sea-frontage of the town) would render about 140 of the existing gas lamps unnecessary, and thus save about £500. But this comparison is scarcely a fair one, as the gas lamps give a light in no way approaching that afforded by electricity.

AUSTRALIAN TELEGRAPHY.—At the close of 1879 some 31,556 miles of telegraph wire were at work on the Australian Continent, and 40,634 miles with Tasmania and New Zealand added.

THE New York Gold and Stock Company, America, intend to replace their open wires by underground ones on the Brooks' paraffin oil system.

WE are informed that the difficulties which have hitherto prevented the United Telephone Company extending their exchange system over the whole metropolis, owing to the Post Office monopoly, have now been removed. The Post Office has granted a licence to the company to erect telephone exchanges, they paying the Post Office an annual royalty on the subscriptions received.

M. VAN MALDEREN, the constructor of the well-known "Alliance" dynamo machine, died lately in Brussels, at the age of 70.

IN the miscellaneous departments, United Telephone Shares were in considerable demand, on the understanding that the existing disputes with the British Gower-Bell Company have been satisfactorily disposed of. We believe we are correct in saying that a new company will be formed harmonising all interests.

A BILL has been introduced into Parliament for the purpose of authorising the erection of a system of pneumatic clocks in the streets of London.

IT is said that the Telephone Company in Belgium has inaugurated a system by which subscribers leaving word the previous evening may be awakened at any hour in the morning by means of a powerful alarum.

THE offices of the Lancashire and Yorkshire Railway, at Hunt's Bank, Manchester, have been lighted by means of 28 Swan lamps. A single A Gramme generator is used for the purpose.

A NEW company has been established in Belgium under the title of "La Force et l'Electricité." The object of the company is to manufacture electrical apparatus of all kinds.

A MAGNETO-ELECTRIC machine for lighthouse purposes has recently been completed by the inventor, M. de Meritens. The machine will sustain 30 Jablochkoff lights with an expenditure of 15 horse-power.

A NEW alarm thermometer has recently been patented by Herr Finger, of Coblenz. The apparatus consists of a mercurial thermometer, on the top of the mercury column of which a small magnet floats. A magnetic needle, the movement of which closes a contact in circuit with a battery and alarm, is set at any required height close to the tube, and when the magnet on the mercury has risen to that particular height the needle is attracted and the alarum sounded.

M. DAUDIGNY, electrical engineer in Paris, has sent to the Municipal Council a petition asking for authority to establish on the top of the Colonne de Juillet a large electric lamp fed by a magneto-electric machine of fifty horse-power. This enormous light is to be diffused by a large reflector of special construction.—*Nature*.

A MOST successful experiment in theatre illumination was tried on March 30 and 31, at the Athenæum of the Rue des Martyrs, Paris, with the Werdermann incandescent light. The peculiarity of it is that it can be graduated at will for scenic effects, either by introducing resistance coils or varying the velocity of the Gramme machine. These experiments were witnessed by several influential members of the Municipal Council, who on the following morning proposed an inquiry into the propriety of obliging all the theatrical managers to light their halls with electricity.—*Nature*.

THE employment of tricycles for the use of telegraph messengers in New South Wales is being instituted.

THE FARADAY LECTURE.—At the triennial meeting of the Chemical Society, on the 6th inst., held at the London Institution, Professor Helmholtz delivered the Faraday lecture for the present year. A crowded and distinguished audience were assembled. Professor Roscoe, Professor Tyndall, Sir W. Thomson, Sir J. Lubbock, Professor Siemens, were present, amongst many other scientific men. Before the delivery of the lecture, Professor Helmholtz was presented with the Faraday medal for the year. Professor Roscoe, as president of the Chemical Society, said he had the honour to present him with the medal, together with (through the kindness of Mr. Matthey) a replica in palladium. The applause with which their honoured guest had been received assured him that no formal introduction was necessary. He had only to say that Professor Helmholtz, eminent as an anatomist, a physiologist, and a mathematician, was now claimed by them as a chemist. The lecturer then proceeded to trace the modern development of Faraday's conception of electricity, illustrating his lecture with an electrometer and other apparatus. Faraday, he said, amidst all his speculations and conceptions, always kept within the domain of phenomena. His theory was to express in his new conceptions only facts. The researches of Mr. Clarke Maxwell and others who had followed him had tended to show that his fundamental conception of electricity was the only one which was not in actual contradiction to the accepted theory of dynamics, and it promised therefore to receive general acceptance. Specially dealing with the subject of electrolysis, Professor Helmholtz pointed out the possible influences of electricity in chemical changes, and by showing that the electrical conditions of atoms corresponded with the combining conditions, as set forth in the chemical doctrine of quantivalents, opened out a wide field for discussion and investigation. Professor Roscoe, in moving a vote of thanks to the lecturer, made some further reference to Faraday, whose conceptions, he remarked, were entirely in accordance with all the modern developments of electrical science. The vote was seconded by Professor Tyndall; while thanking Professor Helmholtz for his address, he took the opportunity of paying a tribute to the private character as well as to the public achievements of Faraday.

BROOKS' CABLE AT BRUGES.—The following tests of the insulation and electrostatic capacity were made on the 18th March of this year, by Mons. Dumont:—

Temperature, 3° C.

Tested Wires.	Insulation, per Kilometre.	Electrostatic Capacity, per Kilometre.
1	211 megohms.	0,095 microfarad.
2	164 "	0,140 "
3	185 "	0,125 "
4	152 "	0,133 "
5	179 "	0,138 "
6	173 "	0,146 "
7	133 "	0,135 "
8	164 "	0,135 "
9	158 "	0,143 "
10	146 "	0,130 "
11	164 "	0,130 "
12	133 "	0,140 "
13	133 "	0,135 "
14	164 "	0,133 "
15	133 "	0,125 "
16	164 "	0,140 "
17	133 "	0,135 "
18	185 "	0,130 "

THE TELEGRAPH CLERKS.—The return moved for by Mr. E. D. Gray, M.P., of the number of telegraph clerks who have resigned since 1872, has been published. The numbers were: in England—males, 1,192; females, 636. Scotland—males, 136; females, 66. Ireland—males, 159; females, 54; total, 2,343. Showing that about one-third of the staff left for more remunerative employment, or about one-half of those who had proved themselves to be efficient in their service. The return does not include deaths or dismissals. In the face of these figures, it is desirable, nay, imperative, that Mr. Fawcett should take the briefest way, consistent with thoroughness, to remedy a state of things which is not compatible with the dignity of a Government department. We have on other occasions protested against the telegraph department being regarded as a dividend paying concern, and it is clear that, although the public should pay a trifle more in taxes, a greater gain would be made by the nation in retaining the best telegraph clerks, and paying for them at equitable rates.

TELEGRAPHING THE RESULT OF THE OXFORD AND CAMBRIDGE BOAT RACE.—The National Associated Press despatch giving the result was transmitted from the point of the finish to the London Agents' office, and filed with the Direct United States Cable Company, who transmitted it to New York in twenty-seven (27) seconds. This perhaps is the quickest time ever made by any cable company, and as such is worthy of note.

IN the litigation between the Post Office and the Edison Telephone Company, the Attorney-General on the 11th inst. applied to two judges of the High Court to vary the decree restraining the company from continuing the business they had been carrying on. The litigation had now come to an end. When once the claim of the Crown to the monopoly was admitted,

they would be ready, in the interests of the public, to grant licences, so that there might be no impediment in the way of the active carrying on of the telephonic communication. The application was granted. A similar application was granted in the case of the Bell Company.

Proceedings of Societies.

THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.

A CONVERSAZIONE of this Society, on the occasion of Professor Helmholtz's visit to London, was held on the 11th inst. in the Rooms of the University College, Gower Street (kindly lent by the Council of the College). A large number of members and visitors were present, and were received by the President of the Society, Professor Carey Foster, F.R.S., in the Library of the College. A large collection of electrical apparatus and appliances were exhibited by the following gentlemen: R. Anderson, Professors W. E. Ayrton and J. Perry, Shelford Bidwell, M.A., LL.D., E. B. Bright, Latimer-Clark (Past President), Latimer-Clark, Muirhead & Co., James Coxeter, R. E. Crompton, Messrs. Elliott Bros., Professor Carey Foster (President), W. Graves, Professor Kennedy, J. A. Lund, G. Lund, R. S. Newall, W. H. Preece (Past President), Robert Sabine, Messrs. Siemens Bros., the Society of Telegraph Engineers and of Electricians, C. E. Spagnoletti, A. Stroh, C. M. Whipple (Superintendent Kew Observatory). The rooms were lighted by a number of Mr. Swan's incandescent lamps, and the corridors and courtyard by Mr. R. E. Crompton's arc lamps.

PHYSICAL SOCIETY.—MARCH 26th.

Professor FULLER in the Chair.

New member—Mr. LEWIS WRIGHT, author and editor.

DR. JAMES MOSER read a paper on electrostatic induction especially relating to the branching of the induction in the differential inductometer and in the electrophones. The author's experiments bore out the hypothesis of induction as enunciated by Faraday.

Prof. AYRTON suggested the importance of adding guard rings to the small plates of the five plate inductometer or balance, since without this, mathematical calculations could not be accurately applied, and the experimental determination of specific inductive capacity would be doubtful.

Dr. MOSER pointed out that though the theory was not absolutely correct it lay with the experimenter to get results very approximately correct.

Prof. REINOLD, one of the secretaries of the Society, read a paper by himself and Prof. RÜCHERT on the electrical resistance of liquid films, with a revision of Newton's scale of colours. The experiments were in continuation of those published by the authors in 1877. Their object was to determine whether a film thinning under the action of gravity gave any evidence, by a change in its specific resistance, of an approach to a thickness equal to twice the radius of molecular attraction, and also to devise a method of finding the amount of water which might be absorbed by or evaporated from it.

The thickness of the films was determined from their colour by means of two beams reflected from different mirrors on them. Newton's scale of colours was revised by observations on Newton's rings, and partly by more than 2,000 observations on the rings themselves. The thicknesses determined by direct observations on Newton's rings and those in the corrected table rarely differ by 1 per cent., while Newton's scale in parts differs from both by as much as 10 per cent. of the thickness.

The films were formed from a solution of oleate of soda in glycerine, with a little nitrate of potash added to increase their electric conductivity. They were blown in a glass case from which the outer air could be excluded. Precautions were taken to keep the air in contact with the films inside the case at a proper humidity. These consisted in placing discs containing the solution at the bottom of the case, and suspending within it sheets of blotting paper the lower edges of which dipped into the liquid. A hair hygrometer indicated changes in the humidity of the interior. The resistance of the films was measured by piercing them with gold wires, which were connected with the electrodes of a quadrant electrometer. The resistance of the film between the needles was calculated by comparing the deflection caused by the difference of potential of the two wires when a current was passing through the film with that produced by the difference of potential above and below a known resistance placed in the same circuit. The specific resistance of the liquid from which the films were formed was measured by a method identical in principle with the above. The liquid was contained in a glass tube with turned up ends. Platinum wires were cemented into small holes drilled in the straight part of the tube, and their difference of potential compared with that of two points in the same circuit separated by a known resistance. This method has the great advantage of getting rid of any difficulties connected with polarisation. Test experiments on sulphuric acid proved the method to give results agreeing with those of Kohlrausch, who employed alternating currents and Wheatstone's bridge.

The results of the experiments may be summed up as follows:—It is difficult to form a soap film under conditions precluding a slight evaporation or absorption of water, but the more nearly these conditions are attained the more closely does the specific resistance of the film agree with that of the liquid in mass. The films observed under the most favourable conditions obeyed Ohm's law with great accuracy and much better than the others. The films indicate no approach to a thickness equal to the diameter of molecular attraction. A soap film may even in an inclosed space readily lose 23 out of 57·7 volumes of water contained in every 100 volumes of the solution, when special precautions are not taken to maintain the surrounding space in a constant hygrometric condition.

Prof. AYRTON suggested that in measuring the liquids and film the distance between the electrodes should be varied.

Prof. GUTHRIE pointed out that the results of Prof. Reinold and Kohlrausch agreed with his own in showing that the conductivity of liquids obeyed Ohm's law.

APRIL 9.

Professor W. G. ADAMS in the Chair.

Professor HELMHOLTZ was elected an honorary member of the Society, and Dr. JAMES MOSER an ordinary member.

Dr. J. H. GLADSTONE read a note on thermal electrolysis, by himself and Mr. ALFRED TRIBE. The authors found that when sheet silver was plunged into fused silver chloride, or iodide of silver, crystals of silver formed on the sheet. Similarly, copper immersed in fused cuprous chloride, copper crystals deposited on it, and when zinc was placed in melted zinc chloride, or iron in melted ferrous chloride, these two metals crystallised on the plates. They found this to be due not to a difference in the physical condition of the rolled metals, but on the unequal heating of the different parts of the immersed metals. By the contact theory of voltaism, there will be a difference of potential between the metal and the liquid chloride in contact with it, and this difference of potential will vary with temperature. Since all parts of the immersed metal cannot be supposed at the same always, there is the possibility of a current being set up and consequent electrolysis of the salt. This view was corroborated by heating the metal unequally, when a crop of crystals appeared in the cooler part of the liquid. Again, two silver rods connected together, were plunged, the one in a hotter, the other in a cooler part of fused silver chloride, and at the end of fifteen minutes the latter was studded with crystals of silver whilst the former was clean. A galvanometer showed a stronger current between the rods the greater the difference of temperature between the parts of the fluid in which they were placed; and transposing the rods reversed this current. These experiments bear on the nature of voltaic action, and form a lecture illustration of the conversion of heat into electricity and chemical force.

Mr. W. H. WALENN stated that he had found when zinc is immersed in an electro-brassing solution, crystals of brass (*i.e.*, zinc and copper) were deposited on it.

Capt. ABNEY exhibited a number of photographic negatives taken by himself and Col. FESTIN by radiation through thin sheets of ebonite. The light from the positive pole of an electric lamp was sent through a thin sheet of ebonite, $\frac{1}{64}$ in. thick, and photographs taken showed the radiation to have a low wave length from 8,000 to 14,000. The carbon points of the lamp could be photographed through the sheet, and Col. FESTIN observed the sun's disc through it.

The ebonite showed a grained structure, and different samples of ebonite gave different results, but all gave some result in course of time at least; old ebonite, like that used in some of Mr. Preece's experiments, scattering the light more than new ebonite. Dr. MOSER exhibited the passage of the rays through the ebonite to the audience by means of a galvanometer. Prof. GUTHRIE observed that Capt. ABNEY had proved light as well as heat traversed the ebonite, and Dr. COFFIN stated that the composition of ebonite apparently the same might vary considerably.

Prof. HELMHOLTZ addressed the meeting on the localisation of objects by the eyes. We estimate distance with one eye by the outlines of the more distant objects being covered by the nearer ones where they meet, and by the shadows thrown by the anterior objects. These conditions are very rarely overpowered by others, as, for instance, binocular vision. This is shown by Dove's pseudoscope, and the fact that closing or blinding one eye makes little difference to the power of judging distance, especially when not very close to the eye. The relative shifting of objects as the eye is moved from side to side, or to and fro, or up and down, which may be called the parallax of motion, is also a strong factor in estimating distance. The author concludes from a study of the stereoscope that the perception of the absolute convergence of our eyes is very indistinct, and that only differences of convergence related to apparently near or distinct objects produce the stereoscopic effect. Recent observations of his show that the incongruity between the degree of convergence and the parallax of motion is perceived with great accuracy. Dr. STONE remarked that a person suddenly blinded in one eye acquires a new judgment of distance by moving the head; and Mr. LEWIS WRIGHT pointed out that santonin, which changes the sense of colour, also appears to change the sense of distance.

New Patents—1881.

1358. "Electric lamps." R. HARRISON and C. BLAGBURN. Dated March 26.

1384. "Electric lighting apparatus." W. R. LAKE. (Communicated by A. G. Holcombe.) Dated March 29.

1393. "Electric drills." J. W. THOMSON. Dated March 29.

1395. "Electrical apparatus for the transmission or reproduction of sound." W. R. LAKE. (Communicated by A. E. Dolbear.) *Complete*. Dated March 29.

1412. "Manufacture of carbon for incandescent electric lamps." J. SCOTT and W. H. A. RESTER. Dated March 31.

1422. "Improvements relating to the production of electric light." W. CROOKES. Dated March 31.

1442. "Electric batteries." F. R. DE WOLSKI. Dated April 1.

1447. "Dynamo-electric, or magneto-electric machines." C. W. SIEMENS. (Communicated by Siemens and Halske.) Dated April 1.

1453. "Interlocking of railway telegraphic block instruments, points and signals, and apparatus for that purpose." C. HODGSON. Dated April 2.

1474. "A new or improved apparatus for laying underground telegraphic or telephonic conductors." J. C. MEWBURN. (Communicated by J. Bourdin and Gen. S. J. de Maltzoff.) Dated April 5.

1526. "Improvements in electric lamps, and in electro-magnets applicable to these and to other electrical purposes." Dated April 7.

1536. "Electric lighting apparatus." J. L. A. DUPONT-AUBERVILLE. (Communicated by F. Delaye.) Dated April 8.

1543. "Electric lamps." S. G. L. FOX. Dated April 8.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1880.

3025. "Electric lighting." PETER JENSEN. (A communication from abroad by Michael Avenarius, of

Kiev, Russia). Dated 22nd July. 6d. In this invention each of the conducting wires of the burners is connected to the corresponding electrode of a voltameter.

3041. "Producing and directing electric currents, &c." CHARLES GODFREY GUMPEL. Dated 24th July. 2d. Relates to apparatus for producing, directing, and intensifying electric currents and applying them for communicating power to a distance, and controlling such power. Instead of winding the wires of the inductors of the dynamo machine in the usual way, that is to say, with the secondary coil superposed on the primary coil, these coils are wound together, that is to say, the primary wire of considerable sectional area along with a number of secondary wires of smaller area, thus obtaining a juxtaposition throughout the coil of the secondary and primary wires, and bringing most of the secondary coils nearer to the core. (*Provisional only.*)

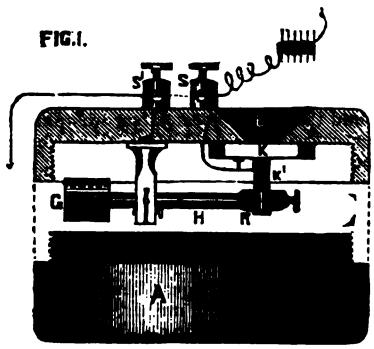
3219. "Obviating effects of extraneous electrical disturbances on telephonic lines." JOHN IMRAY. (A communication from abroad by Doctor Cornelius Herz, of Paris.) Dated 6th August. 2d. Relates to means of obviating the effects of disturbances on telephonic lines, for which purpose the line wire instead of being led directly to earth from the receiving instrument is made to terminate in a number of fine points extended over a considerable area, and another set of such points in close proximity to the former set communicate by a wire to earth. Thus electricity in passing from the one part of the line to the other forms a brush, or passes by a diffused and silent flow from the one set of points to the other. The space between the two sets of points may be filled with a medium, such as alcohol, oil, or hydrocarbons, or with gas other than air, or air or gas more or less rarefied. (*Provisional only.*) (*See* TELEGRAPHIC JOURNAL, 1st March.)

3310. "Insulating telegraph conductors," &c. EDWIN THOMAS TRUMAN. Dated 14th August. 4d. Relates to improvements in insulating telegraph conductors, and in the mode of and machinery for manufacturing telegraph conductors, the improved machinery being also applicable for other purposes.

3424. "Electric conductors," &c. GEORGE BARKER. (A communication from abroad by William W. Jacques, of Boston, America.) Dated 24th August. 4d. The object of this invention is to provide an insulating coating for telegraph wires and other electric conductors which shall have a high insulating power and at the same time be tough, pliable, and elastic under any conditions of temperature or weather to which it would naturally be exposed, which shall be entirely impermeable to water, gases, and moisture, and not affected by atmospheric influences nor liable to change with time, and, finally, which shall be much cheaper than substances usually employed for the same purpose. The wire is covered with rubber, whose pores are thoroughly impregnated by a peculiar process with a mixture of about equal parts of Venice turpentine and beeswax, and then coating this impregnated rubber with more of the preserving compound, sulphur, and various dilutants, by continued working on warm rolls.

3420. "Apparatus for transmitting sounds." FREDERICK ROBERT VON WREDEN, M.D. Dated 23rd August. 6d. Relates to an improved microphonic transmitter. T is a very thin (from 0·0002 to 0·003 of an inch thick) and tightly stretched membrane, T (figs. 1 and 2). An electrically conducting piece, K, of carbon is fixed on the membrane, T, and communicates by means of a fine wire, *a*, with a terminal, *s*. H is a contact regulator. On one end of this regulator is fixed a thick ring, R, in which is fixed a piece of carbon, K^1. The piece, K^1, is in direct contact with the cylindrical piece, K, fixed on the membrane, and through the

FIG. 1.



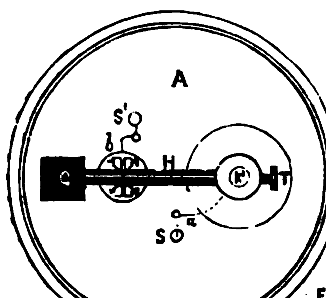


FIG. 2.

metallic contact regulator, H, and a fine copper wire, *b*, is in connection with the terminal, s_1. The other end of the contact regulator is provided with a fine, accurately cut screw thread, on which a counterweight, G, can be moved to adjust the degree of contact or pressure between the two pieces of carbon, K, K^1.

3496. "Apparatus for obtaining electricity." CHAS. WEIGHTMAN HARRISON. Dated 28th August. 2d. Relates to improvements in apparatus for obtaining electricity. (*Provisional only.*)

3509. "Electric lamps." JOHN HOPKINSON. Dated 30th August. 2d. Each carbon is carried from the piston of a hydraulic cylinder. Each cylinder is either so arranged that when fluid is allowed to flow out from that cylinder the carbon it carries advances. The passage of fluid into a cylinder from a cylinder, or from one cylinder to the other, is controlled by a valve, which is opened or closed by an electro-magnet. (*Provisional only.*)

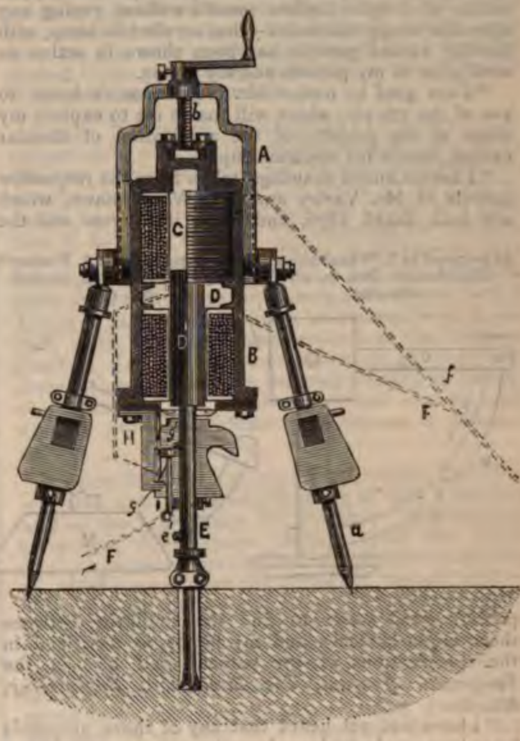
4850. "Switches and apparatus for telephone lines." SYDNEY PITT. (A communication from abroad by Charles Darwin Haskins, of New York.) Dated 23rd November. 6d. Relates to electric calls for use on telephone circuits. Its object is to enable signals to be exchanged between a central office and any station on a given circuit without operating the signal or call bell of any other station on the same circuit, and to provide a means by which persons at other stations will be prevented from interrupting or overhearing a message which is being sent by a person using a telephone at another station on the same circuit, and to supply a method by which the operator at the central office of a telephone exchange will be enabled to set the different instruments at a common starting point.

4866. "Electric lighting apparatus." W. R. LAKE. (A communication from abroad by H. Maxim, of Brooklyn, America.) Dated 23rd November. 6d. Relates to the electric lamp described on page 144.

5091. "Electric telegraphy." H. J. HADDAN. (A communication from abroad by Samuel Latham Mitchell Barlow, of New York, Assignee of the Inventor, Dr. Orazio Lugo, of the same place.) Dated 7th December. 6d. The object of this invention is to produce intelligible signals in a long telegraphic circuit with great distinctness by means of secondary induced currents or pulsations of high electromotive force or intensity, which are generated by means of a battery or batteries of comparatively small power through the medium of induction coils. This is effected by putting a telegraphic key, which sends reversed currents from batteries connected to the front and back stops, in circuit with the primary wire of an induction coil; the secondary currents from the secondary coil pass out to line, and at the receiving station pass through the primary of an induction coil which has a telephone in circuit with the secondary wire. The telephone is then read from as in an ordinary sounder.

5092. "Magneto speaking telephony." H. J. HADDAN. (A communication from abroad by Samuel Latham Mitchell Barlow, of New York, assignee of the inventor, Franceso Rosetti, of Padua, Italy.) Dated 7th December. 6d. At the sending and transmitting stations Bell telephones are connected to the primary wires of induction coils, and the secondaries of the latter are connected to line.

5152. "Electric drills." SYDNEY PITT. (A communication from abroad by Charles E. Ball, of Philadelphia, United States of America.) Dated 9th December, 6d. Relates to drills of the class reciprocated by electro magnetism. Its object is to secure a simple, efficient, and durable machine. A is a frame or yoke mounted upon a tripod, the legs, *a*, of which are variable in length so as to adjust the drilling tool properly relatively to the substance to be operated upon. A stock or cylinder, B, slides freely endwise in the frame, its movement being controlled by an adjusting screw, *b*. Coils or helices, C, D, of insulated wire wound in a way usual with electro-magnets are secured in the stock, B, end to end in the same axial plane, but with a space between them. An ordinary soft iron core, D[1], common to both these helices has the capacity of sliding freely endwise axially therethrough, the core it will be observed being about one-third longer than either coil, so as to always leave it within their magnetic field. The upper end of the cylinder, D, terminates in a small chamber in which the core, D[1], plays on its back stroke; the confined air in this chamber is thus compressed at each back stroke, and acts as a buffer to prevent shocks or jars. A tool-stock or drill-holder, E, constituting a prolongation of this core carries the drilling-tool in usual well-known ways. The conductor from a dynamo or magneto-electric machine or generator is divided, each branch being connected with its respective coil, so that the circuit may pass alternately through each one as it is shunted by the action of the rheotome or circuit-changer hereinafter described. One terminal of the coil, C, leads to contact, *g*, and a terminal of the coil, D, likewise connects with another contact, g^1, both of said contacts being insulated from each other, but secured to the same pendant or bracket, H, of the stock, B. The return wire, F[1], to the generator is secured to a T-shaped bar, I, located between the drill-stock, E, and pendant, H, above mentioned. With the parts in the position shown in the figure, one coil, C, is in circuit, while the other one, D, is inactive. The operative force of the coil, C, draws the core, D[1], into it and retracts the drill, at the same time moving the bar, I, out of contact with the contact, *g*, and into contact with the contact, g^1, this bar being moved at the proper time by the tappets or wipers, *e*, e^1, on the drill-stock, E. As the core, D[1],



reaches the limit of its back stroke the bar, I, comes in contact with the contact, g^1, thus changing the current from the back coil, C, to the front one, D, causing the core to be drawn forcibly into said coil, thus producing the necessary stroke of the drill. When the forward stroke of the drill is completed, the stud, *e*, strikes the plate, I, and forces it against the contact, *g*, thus again throwing the coil, C, into circuit, and the coil, D, out of circuit, and retracting the drill. These operations being repeated at every stroke of the drill produce a very rapid and effective reciprocation.

Correspondence.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—I beg to forward you a copy of a letter I have sent to the editor of *La Lumière Electrique*, which has reference to a letter to which you kindly gave publicity in your columns some time ago.

Knowing the unbiassed tendency of your Journal to aid all workers in science, you will, I am sure, by giving publicity to this letter, aid me in maintaining my claim to the priority of the application of circular carbon pencils for electric lamps.

I am, dear Sir, yours very truly,
CHAS. F. HEINRICHS.

25, Guildford Street, Russell Square, W.C.
London, March 19, 1881.

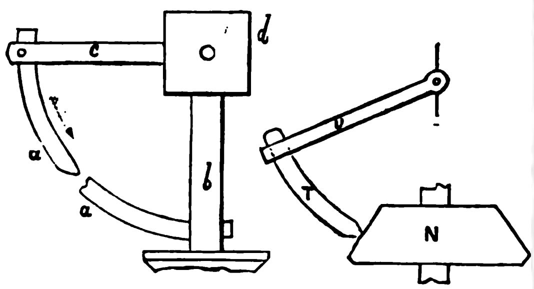
To the Editor of La Lumière Electrique, *Paris.*

"Sir,—I regret not having noticed, until a few days ago, your answer to my letter in your first number of this year, of the 11th December last year, in which you credit Mr. R. S. Varley with the priority of the application of circular carbon pencils without paying any attention to my statement—that no electric lamp, with circular carbon pencils, has been shown in action or used prior to my patents and my lamps.

"I am glad to notice Mr. Werdermann's letter to you of the 5th ult., which will enable me to explain my claim of the priority of the application of circular carbon pencils for electric lamps.

"I hereto annex drawings taken from the respective patents of Mr. Varley and Mr. Werdermann, which are both dated 1876, and leave it to your and the

As proposed by R. Werdermann's Specification, Dec. 12, 1876. No. 4805.	As proposed by S. A. Varley's Specification, Dec. 19, 1876. No. 4905.



public's good sense to find the similarity between these crude sketches and my lamps, as described in the specifications of my patents, and also in the *Telegraphic Journal*, *The Electrician*, *Engineering*, &c., &c.

"I have not yet heard that any of those proposals have been made or have been in action, and I do not see how they could have been put in action *without adding further invention.* It is evident that the man who proposes to find the North Pole cannot claim any credit from the man who actually finds the North Pole. Thus, Mr. Varley and Mr. Werdermann having *only proposed* to use a rod of carbon forming a portion of a circle (Mr. Varley does not mention at all in his specification that the carbon rod forms a portion of a circle, nor that it is meant to be a curved carbon), cannot have any claim on the invention of my lamps, in which I use two semi-circular or two nearly complete circles of carbon, and to my best knowledge none of the gentlemen have ever put forth such a claim. In his letter of the 5th ult., Mr. Werdermann admits that he has *only proposed the use of carbon rods forming a portion of a circle,* and consequently, he can have only such claim to the actual application of circular carbons pencils as the man who *only proposed* to find the North Pole. The mere idea of using circular carbon pencils does not make the invention, although the mere idea may have been registered in a patent.

"Many gentlemen have told me that they also have had the idea of using circular carbon pencils (that we always hear after an invention has been accomplished, as the large class of would-be inventors cannot distinguish the accomplished invention from the mere proposal). Knowing that I address in you gentlemen of literary and scientific standing, I beg to draw your attention to the three following manners by which alone priority of invention can be proved :—

"Firstly, that the invention has been fully described *in all its details* in the specification of a patent.

"Secondly, that the invention has been shown in operation before the public.

"Thirdly, that the entire plan and features of the invention have been laid before a scientific body.

"As none of the gentlemen have complied with any of these terms, but as I have complied with all of these terms, I hope now that you will credit me with the priority of the application of circular carbon pencils.

"I should never have thought of contesting this question if you had not stated, firstly, that I have re-invented M. Dubos' regulator; and I shall now show that your statement is entirely erroneous, but *that it is possible* that M. Dubos has adopted my plan of using circular carbons.

"In June, 1878, M. Dubos applied for a patent in England for an electric lamp with *straight* carbons, of which Colonel Bolton, in his paper, 'Some Historical Notes on the Electric Light,' read before the Institution of Telegraph Engineers, says as follows :—

"'1878. Dubos. 2,401. "Improvements in apparatus for producing electric lights." (*Provisional protection only.*) Patents balancing two forces, one produced by a spring weight, &c., and the other by electro-magnetism for keeping the (straight) carbons in the proper positions.'

"This is practically patenting an electric lamp such, as for example, Staite patented in 1847, thirty-one years before.

"I applied on 13th November, 1878, for an English patent, in which I described and patented the application of circular carbon pencils in the same manner as I continue to employ them, and a few days later I myself compressed the first circular carbons ever made to my knowledge, and which were baked (obligingly) at the Battersea Crucible and Plumbago Co.'s Works. Two months later I burnt the same carbons in a rough model lamp made according to my invention.

"Already, in July, 1878, I had asked a large firm to assist me in making my lamps.

"M. Dubos could not have had the idea of employ-semi-circular carbons in June, 1878, as he would have noticed it in the specification of his patent before-mentioned. On 20th January, 1879 (two months after I had applied for my patent in England, after I had actually made circular carbons, and after workmen had commenced making my lamps), M. Dubos applied, firstly, in Germany for a patent, in which he again patents the mechanism mentioned before by Colonel Bolton, and only adds circular carbons to them.

"As regards the mechanism I may state that it will never answer, as no allowance has been made for the feed of the carbons in proportion to their consumption.

"From the before-going facts it will be seen to be impossible that I could have re-invented M. Dubos' regulator, which is as old as 1847, while my regulating mechanism is original and successful.

"Hoping that, in justice to my invention, you will kindly allow this explanation a space in your next issue

"I beg to remain, your obedient servant,

"CHAS. F. HEINRICHS.

"Guildford Street, Russell Square,

"London, March 17, 1881."

W. Fowler.—The illustrations of the "Duplex and Single Switch," given in our issue for March 15th, pages 100 and 101, are quite right, but the lettering of the same (as you point out) is incorrect, in so far that the letters do not correspond with those given in the old form of switch. The words on page 100, "(which correspond to those in the old form of switch)," should be cancelled. We are obliged to you for pointing out the error.

City Notes.

Old Broad Street, April 11, 1881.

THE EASTERN EXTENSION TELEGRAPH COMPANY (LIMITED).—The fifteenth ordinary general meeting of the Eastern Extension, Australasia, and China Telegraph Company (Limited), was held on April 6th, 1881, at the Cannon Street Hotel; Mr. J. Pender, M.P., presided. The report of the directors, which referred to the half-year ending the 31st of December, 1880, stated that the gross receipts, including Government subsidies, had amounted during the half-year to £193,435 9s. 6d., against £165,930 11s. 2d. for the corresponding period of 1879, showing an increase of £27,504 18s. 4d., of which £21,133 6s. 8d. was the amount received from the Australian and Manila Governments on account of subsidies. The working and other expenses, including a sum of £22,932 0s. 5d. for cost of repair of cables and expenses of ships, together with income tax, would absorb £57,592 1s. 2d. against £57,451 for the corresponding half-year, leaving a balance of £135,843 8s. 4d. From this was deducted £42,350 for interest on debentures and contribution to sinking funds for redemption of the Manila and Australian Government Subsidy Debentures, leaving £93,493 8s. 4d. as the net profit for the half-year, which, with £35,610 10s. 5d. brought forward, made a total of £129,103 18s. 9d. to be dealt with. One interim dividend of 1¼ per cent., amounting to £24,968 15s., had been paid during the half-year, and it was now proposed to distribute another of a like amount, together with a bonus of 1s. per share, payable on the 14th April, which, with the two interim dividends and bonus paid for the first half-year, would make a total distribution of 6 per cent. for the year 1880. The balance, amounting to £69,178 18s. 9d., had been carried to the reserve fund, which now stood at £217,268 1s. The only important interruption during the six months occurred on the Java-Australian section in October last, when the cable was broken down for 17 days; the receipts, however, during this period were not affected, as the traffic was transmitted by the alternative line. There were, however, numerous small repairs which required the services of the Company's maintenance ships during the greater portion of the half-year. All the Company's cables were in good working order. In accordance with the articles of association, Sir Thomas Fairbairn, Bart., the Right Hon. Viscount Monck, and the Right Hon. W. N. Massey, M.P., retired by rotation, and offered themselves for re-election. The retiring auditors, Mr. Henry Dever and Messrs. Quilter, Ball, and Co., offered themselves for re-election. The chairman, who moved the adoption of the report, said that during the past year the working expenses had decreased, as compared with the previous year, by £5,431, although extra works had been carried out. All the cables were in good order, but £40,000 had had to be spent in the course of the year in repairs. One of the Company's ships had been at sea 142 days and another 144 days, but all the pieces of cable picked up were replaced by the most improved kind of cable which could be secured. He hoped and believed that, with the improvement of general trade, telegraph business would also improve. Mr. Massey, M.P., seconded the resolution. The chairman, in answer to questions, said he thought the sum of £200,000 as a reserve fund, with a capital of £3,000,000, was not the full amount which they should reach. The directors for the first time had added 1 per cent. to the dividend, but they felt that before going further in that direction the reserve should be still further increased. For the purpose of repairs the Company had determined to use its own ships, for by hiring vessels the expense must be much greater than the Company need expend. Amalgamation had been carried as far as possible with other companies, having regard to the interests of the shareholders. The loss by any further extension of amalgamation at present must cause loss to everybody concerned by the increased expenditure which would be involved. The report and accounts having been adopted, the retiring directors and auditors were re-elected. The proceedings closed with a vote of thanks to the chairman and directors.

GREAT NORTHERN TELEGRAPH COMPANY.—The balance sheet of this Company, for the year 1880, shows that the receipts for this period amounted, with the amount brought forward of £16,242 7s. 4d., to £238,763 4s. 9d., or with interest and sundries added, to a gross total of £260,107 1s. 10d. The expenses for the same period were £67,775 8s. These, with interim dividends paid on 150,000 shares at 5 per cent., £75,000, allow of an addition to the reserve and renewal fund of £55,555 11s. 1d.; an addition to pension fund of the staff, £525, 17s. 10d.; remuneration to the board of directors, £1,500; an extra dividend of 5s. on 150,000 shares, £37,500; and to a carrying forward of balance of £22,250 4s. 11d. The reserve and renewal fund, with the proposed addition, will amount to £180,425 4s. 10d.

DIRECT SPANISH TELEGRAPH COMPANY (LIMITED).—At the ordinary general meeting of this Company, held on the 31st ultimo, the chairman (Mr. Etlinger), in moving the adoption of the report (see TELEGRAPHIC JOURNAL, previous issue), and after commenting on the various paragraphs contained therein, said:—The only word of interest which he could add would be to tell them how the new half-year had gone so far. In January, February, and March, up to yesterday, and allowing for to-day, the receipts had been £4,875. If the next three months were the same, of course there would be £5,008 more to add, or nearly £10,000. It was right to say that in February the Eastern cable broke down, and they made a little extra profit; but taking this into consideration, and allowing that for April, May, and June, they would make as much as the average they had made in January and March (leaving out February), in that case the receipts for the half-year would amount to £9,375, which, after paying the preference dividend, would leave a surplus of £4,000. How this would be divided it would not be for him to speak about. The shareholders could very well calculate it. One per cent. on the ordinary shares required £582, consequently anybody who would take the receipts as published in the newspapers, and deduct their expenses at the rate of £2,100 for the half-year, could see how they stood. The expenditure had been slightly increased, as, of course, it would naturally be when more forms, stationery, &c., were required. The motion having been seconded, was carried unanimously. The chairman next moved "that the 10 per cent. dividend on the preference shares for the half-year ending 31st Dec., 1880, together with the arrears of 10s. per share due thereon, making together 20s. for the preference shares, be and is hereby declared, less income-tax." This being seconded was agreed to. The retiring directors and auditor were then re-elected. Mr. Matthew Gray said that the cable was originally laid between England and Bilbao, and had broken almost at once in consequence of a long stretch of deep water. The Barcelona cable had never altered in the least, and never required the outlay of one penny upon it. It was lying on a bed of sand all the way, and none of them would live to see it break. The meeting then terminated with the usual votes of thanks.

The German Union Telegraph and Trust Company (Limited).—The report of the directors to be submitted to the meeting on the 12th inst. contains the accounts and balance-sheet for the eight months ending 31st December, 1880, including in the accounts the coupon to that date receivable from the German Union Company of Berlin. The accounts will in future be made up to the 31st December, instead of the 1st May as heretofore, so as to cause no delay in the distribution of the dividends receivable from Berlin. The total receipts during the eight months amount to £14,486 12s. 7d., which, with a balance of £51 1s. 5d. carried forward from last account, make a total of £14,537 14s. The working expenses for the same period amount to £352 1s. 1d., leaving a balance of £14,185 12s. 11d. Out of this amount an interim dividend of 5s. 9d. per share was distributed on the 21st January last, and the directors now beg to recommend the payment of a further dividend of 8s. 3d. per share, making a total distribution for the year of 14s. per share, free of income-tax, or at the rate of £7 per centum per annum. The directors have also written off £130 from the expenses of formation of the Company, thereby extinguishing that item, and leaving a balance of £139 12s. 11d. to be carried over to the next account. The Company's cable and land lines remain in good order and condition. The total receipts from all sources of traffic show a very marked increase. The total traffic between Germany and Great Britain has nearly doubled since the year 1874, and this satisfactory result is attributable in a great measure to the introduction of the single word tariff in 1878. The traffic sent by the various telegraphic administrations over the Company's lines has almost quadrupled during the same period.

Anglo-American Telegraph Company (Limited).—After placing £37,500 to the renewal fund, it is proposed to declare an interim dividend for the quarter ending 31st March of 1 per cent. on the ordinary stock, and 2 per cent. on the preferred stock.

Globe Telegraph and Trust announce an interim dividend for the quarter ending April 18 of 3s. per share on the preference shares, being at the rate of 6 per cent., and 2s. 6d. per share on the ordinary shares, being, with previous payments, at the rate of 4 per cent.

Western Union Telegraph.—Mr. Hatch has begun a new suit in the Superior Court, and has obtained a temporary injunction against the consolidation of the various companies. The arbitrators appointed to value the plant of the American Union Telegraph Company awarded the Central Construction Company 10,000,000 dols. in stock and 5,000,000 dols. in bonds. About one-half of this was paid previous to the consolidation. Subsequently, the Western Union Company issued its new stock for the balance, and the Central Construction Company divided it up among it stockholders, who are identical with the principal stockholders of the American Union Company.

Indo-European Telegraph Company (Limited).—The dividend for the six months ending December 31st will be 17s. 6d. per share, making 6 per cent. for the year, and a bonus of 10s. per share, and placing £7,500 to the reserve fund.

The following are the final quotations of telegraphs:—Anglo-American, Limited, 58¼-58¾; Ditto, Preferred, 87-88; Ditto, Deferred, 30¼-30¾; Black Sea, Limited, ——; Brazilian Submarine, Limited, 10-10¼; Cuba, Limited, 8¾-9¼; Cuba, Limited, 10 per cent. Preference, 16¼-16¾; Direct Spanish, Limited, 3¾-4¼; Direct Spanish, 10 per cent. Preference, 14-15; Direct United States Cable, Limited, 1877, 11⅝-11⅞; Scrip of Debentures, 103-105; Eastern, Limited, 9¾-10; Eastern 6 per cent. Preference, 12¾-13; Eastern, 6 per cent. Debentures, repayable October, 1883, 104-107; Eastern 5 per cent. Debentures, repayable August, 1887, 102-104; Eastern, 5 per cent., repayable Aug., 1899, 102-105; Eastern Extension, Australasian and China, Limited, 10⅜-10⅝; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 108-111; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 104-106; Ditto, registered, repayable 1900, 104-106; Ditto, 5 per cent. Debenture, 1890, 102-104; Eastern and South African, Limited, 5 per cent. Mortgage Debentures, redeemable 1900, 101-103; Ditto, ditto, to bearer, 101-103; German Union Telegraph and Trust, 11¼-11¾; Globe Telegraph and Trust, Limited, 6¼-6½; Globe, 6 per cent. Preference, 12⅜-12⅝; Great Northern, 12⅜-12⅝; 5 per cent. Debentures, 103-106; Indo-European, Limited, 28-29; London Platino-Brazilian, Limited, 6¼-6½; Mediterranean Extension, Limited, 2¼-2¾; Mediterranean Extension, 8 per cent. Preference, 9¾-10¼; Reuter's Limited, 10⅜-11⅛; Submarine, 270-290; Submarine Scrip, 2⅛-2⅜; Submarine Cables Trust, 100-103; United Telephone Company, ——; West Coast of America, Limited, 4¾-5¼; West India and Panama, Limited, 2⅜-2⅝; Ditto, 6 per cent. First Preference, 7-7½; Ditto, ditto, Second Preference, 6-6½; Western and Brazilian, Limited, 8⅜-8¾; Ditto, 6 per cent. Debentures "A," 104-108; Ditto, ditto, ditto, "B," 98-102; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 122-127; Ditto, 6 per cent. Sterling Bonds, 103-107; Telegraph Construction and Maintenance, Limited, 31⅜-32; Ditto, 6 per cent. Bonds, 106-109; Ditto, Second Bonus Trust Certificates, 3½-4; India Rubber Company, 18⅜-19; Ditto, 6 per cent. Debenture, 103-106.

TRAFFIC RECEIPTS.

Name of Company.	Feb.	March.	Remarks.
	£	£	
Anglo-American ... 1881	49,180	51,540	
1880	40,530	40,280	
Brazilian S'marine 1881	15,104	15,762	
1880	15,517	15,879	
Cie. Française ... 1881	...	...	Not published.
1880	..	..	
Cuba Submarine ... 1881	2,900	3,100	Jan. estimated at £2,800, realised £2,527.
1880	3,140	3,588	
Direct Spanish ... 1881	1,876	1,492	
1880	..	..	
Direct U. States ... 1881	16,390	17,180	
1880	..	13,430	
Eastern 1881	46,463	51,206	
1880	44,591	43,374	
Eastern Extension 1881	28,021	29,661	
1880	25,190	26,425	
Great Northern ... 1881	16,880	18,520	
1880	14,160	16,440	
Indo-European ... 1881	...	...	Not published.
1880	..	..	
Submarine 1881	...	...	Publication temporarily suspended.
1880	..	..	
W. Coast America 1881	...	...	
1880	1,300	1,776	
West. & Brazilian 1881	10,169	10,797	
1880	9,227	9,908	
West India 1881	4,320	...	
1880	5,488	6,075	

THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. IX.—NO. 198.

THE ELECTRICAL RAILWAY.

DETAILS of the working of the Electrical Railway at Berlin are still wanting, though the announcement of the trial trip was made a short time ago. The success of the experiment can hardly be considered doubtful by any one; nevertheless, as the new line is really the first practical one on the new system, its working will be watched with great interest by all concerned in railway matters. Unlike the electric light, the progress of the new method of propulsion for railways will scarcely be watched with jealous eyes, as its success will not clash with any existing interests. Gas companies look upon the electric light as a formidable foe, and not without reason, though their interests are not likely to suffer to anything like the extent which has been predicted; but railway companies and railway engineers will only look upon the electrical railway system as a new source of enterprise to which to turn their attention.

The plant required by companies who light by gas, and those who light by electricity, is of quite a different nature, and it is not interchangeable in any way—that is to say, the plant of the gas company cannot be made to do service for electric lighting; no part of it can be utilised for the purpose.

Again, the capital required for starting an electric lighting system is small. In the case of railways the bulk of the capital is required for the track, which is common to every system of railway locomotion, whether the latter be effected by electrical or other means. Also, the actual cost of working by electricity is not likely to be less than that incurred in working by locomotives; indeed, we are not aware that it has ever been attempted to be proved that it is so. As a rival to existing interests, therefore, the progress of the electrical railway is not to be feared. Its use will not be to compete against existing systems, but rather to fill gaps hitherto left open.

For town work the electrical railway seems eminently fitted, as it possesses the advantage of freedom from noxious fumes, by no means an unimportant advantage, to which those who travel daily by the Underground Railway can testify.

Besides the electrical motors, those worked by compressed air are likely to have a fair share of attention, but the two are not likely to be rivals, as each will probably have its own sphere of usefulness. The compressed air system is an indirect method of obtaining motive power, and in such methods there is always a loss; but the air engine has the advantage of being independent in its action of the state of the track over which it runs, that is to say, mud and water will in no way hinder its action; for tramways, therefore, the compressed air system is admirably suited. For underground railways where the track is completely protected the electrical system would answer well, and it would have the advantage of rendering collisions impossible, whilst the transmission of the power being comparatively direct, the arrangement would be comparatively economical.

ELECTROMOTIVE FORCE OF THE VOLTAIC ARC.

By M. F. P. LE ROUX.

WHEN an electric current is established between two conductors of the same kind by the intervention of a gaseous medium, which is usually the vapour emitted by their substance, the inequality of the temperature of the portions of those conductors which are contiguous to this medium appears to be a general fact. It appears not less general that the extremity by which the positive electricity arrives possesses the highest temperature of the two.

The idea of attributing to this phenomenon a thermo-electric origin is old: it is mentioned in the treatise of Verdet. From the application of the principle of equivalence of heat to electrical phenomena, as explained in the works of Helmholtz, Clausius, and Sir William Thomson, in proportion to the heat disengaged at the point of junction of two heterogeneous substances, there corresponds an electromotive force acting in the reverse direction to the current. M. Edlund remarked, some time ago, that the hypothesis of the resistance of the voltaic arc, considered simply as a conductor, is not sufficient to account for the diminution in intensity which takes place in the current from the battery. Quite recently, M. Joubert (*Comptes Rendus*, July, 1880), in the course of his very interesting researches on magneto-electric machines, has arrived at the conclusion that the resistance of the arc was very small, that the difference of potential which exists between the two carbons was due, for the most part, to an electromotive force resulting from a phenomenon of polarisation of which he reserves the explanation.

I have before had occasion to refer to the experiment of M. Wartmann, who shows that, if the passage of the current is suspended for a small portion of a second, even one-tenth, one can, on re-establishing it, see the arc form itself afresh

without any contact of the carbons being necessary. This fact explains itself very well if it is considered that the carbon vapour, which I think constitutes principally the arc, can last for some time after the cessation of the current, and also that the hot gases which surround the carbons are conductors, as M. Edm. Becquerel has shown.

It being admitted that the passage of the current between the two carbons is due to a difference of potential, this difference should exist a certain time after the cessation of the current, and from the moment that it exists between the carbons still heated and conducting this difference should be manifested on a galvanometer placed in the circuit. I had some time ago endeavoured to show the existence of this difference of potential by means of a kind of double contact breaking wheel, analagous to the distributing wheel which I had employed to cause intermittent currents to pass between two places; but this kind of apparatus presented peculiar difficulties.

It appeared to me a better arrangement to employ a single contact only, worked by hand, to interrupt the current of the battery. With a galvanometer of high resistance a current could be observed over two-tenths of a second after the battery current was cut off, showing the existence of a *reverse* electromotive force. This effect can be produced with the carbons several millimetres apart; but the effects are much more marked when the arc is short at the moment of the cessation of the principal current. The experiment succeeds equally well whether the carbons are in the air or in a vacuum obtained by an ordinary air pump. Phenomena of the same kind can be produced with platinum instead of carbon electrodes. I believe that it is entirely a thermo-electric effect. The carbon would be positive by contact with its vapour in a degree increasing with the temperature.—*Revue Industrielle.*

SIMPLIFIED HOLTZ ELECTRICAL MACHINE.

By GEO. M. HOPKINS.

In the domain of physical science there is nothing capable of being illustrated by more brilliant and pleasing experiments than frictional electricity; the means of studying it experimentally are in every one's hand, and if it were better known, doubtless many who are now comparatively uninformed on this subject would begin to make it a matter of study and experiment.

Many will recall the time in school days when the professor, with great exertion, trundled the ponderous frictional machine from behind the glass doors of the laboratory cabinet, and after no end of wipings, adjustments, and applications of amalgam, and after exerting an enormous amount of muscular force, succeeded in discovering that the atmospheric conditions were unfavourable to the generation of electricity, and the students, after being shocked by a quarter inch spark, were further shocked, and in another way, when informed that the philosophical machine must be re-consigned to its glass housings until a more propitious day.

Such was the general experience of the student of science a few years since, and such it is to-day in some of our educational institutions; but many of our schools—to their credit it may be said—have kept pace with the times and have provided modern apparatus capable of being used successfully under all conditions. The more recent forms of Holtz electrical machine are vastly better than the earlier ones, and the earlier ones were far superior to any of the forms of frictional machine. The makers of the improved Holtz machine in New York, Boston, and Philadelphia furnish them at reasonable prices, but there are numbers of our experimenters and students who would hardly feel warranted in purchasing one of them, who would construct one but for a few difficulties which at first sight seem almost insurmountable to the tyro. The questions that beset the inquirer are: (1) What kind of glass shall be used? (2) How shall the glass be apertured? (3) How shall the parts be adjusted and manipulated to secure the wonderful results attained by this machine?

It is the object of this article to fully answer these queries, and to give such details of construction as to enable any one having even a moderate mechanical ability to make, in a very simple manner, a machine fully as efficient as the best in market; and that, too, without any considerable outlay for materials. Without describing in detail the principle upon which the machine operates—these matters being fully treated in all works on physics—I will describe a machine which was made in odd moments as a matter of recreation and which is as efficient as could be desired, yielding a spark fully six inches in length, equivalent to one half of the diameter of the rotating disc. This machine is shown in perspective in fig. 1, and in plan in fig. 2. Different forms of apertured disc are shown in (3), (4) and (5.) The glass for the discs is selected from common window glass. It should be as thin as possible, of uniform thickness, and flat. It is not essential that the glass be absolutely free from imperfections, although this is desirable. The rotating disc is twelve inches in diameter, the fixed disc is fourteen inches in diameter. I begin with the glass discs, as it is here that most of the difficulty in making the machine is supposed to lie; the especial trouble being in making the aperture in the revolving glass for receiving its hollow shaft, and in making the three large apertures in the fixed glass. I dispense with the hole in the revolving disc, and secure it to a vulcanite collar by means of a cement composed of pitch, gutta percha, and shellac equal parts, melted together. The method of applying the cement for this purpose is to warm the vulcanite collar, then cover it with a thin layer of the cement; then, after making the glass rather warm, lay it on a paper on which are described two concentric circles, one the size of the glass disc, the other the size of the collar, and while the glass is still hot press the collar down upon it. The vulcanite collar is screwed on the end of a wooden sleeve, C, (fig. 2), having at one end a shoulder to receive the collar and at the other end a small pulley to receive the driving belt. The sleeve, C, turns upon a piece of three-eighths inch brass tubing which extends through the vertical post, D, ten inches high and two inches in diameter. The end of the sleeve, C, next the glass disc, B, is countersunk to receive a screw, which enters the end of the brass tube holding the sleeve in place. This screw is covered by the glass when the revolving disc is in its place in the machine. The glass for the stationary or apertured plate, A, is first cut in circular form and then divided diametrically, and the apertures are formed by cutting half from each plate, a very simple matter as compared with cutting the three holes from an entire disc. The lateral holes are two and three-quarter inches long, and one and three-quarter inches wide at the larger end, and their sides are

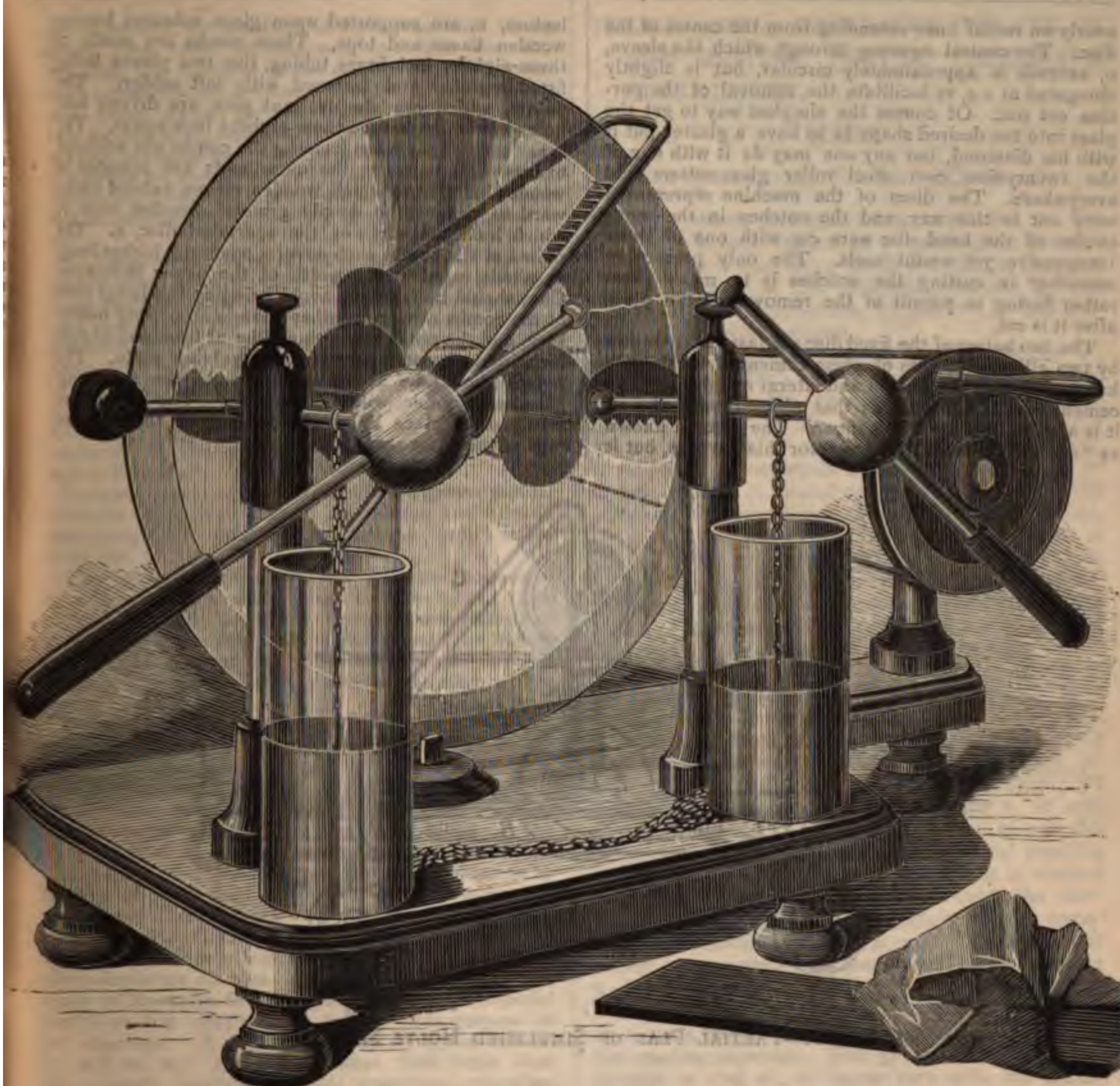


FIG. 1.

APERTURED DISCS.

nearly on radial lines extending from the centre of the disc. The central opening through which the sleeve, C, extends is approximately circular, but is slightly elongated at *e e*, to facilitate the removal of the portion cut out. Of course the simplest way to get the glass into the desired shape is to have a glazier cut it with his diamond, but any one may do it with one of the twenty-five cent steel roller glass-cutters sold everywhere. The discs of the machine represented were cut in this way, and the notches in the semicircles of the fixed disc were cut with one of these inexpensive yet useful tools. The only precaution necessary in cutting the notches is to make them rather flaring to permit of the removal of the piece after it is cut.

The two halves of the fixed disc are fastened together by two elliptical pieces of glass cemented to the two halves, between the central and lateral openings. The cement used is the same as that above described, and it is applied in a similar manner. The cement known as "stratena" answers very well for this purpose, but it must have several days to dry before the machine can be used.

The edges of the glass around the apertures and along the seams should be varnished with the best quality of alcoholic shellac varnish to prevent the accumulation of moisture.

Paper inductors, *c*, are attached to opposite sides of the apertured glass by means of starch paste made by cooking starch until it begins to thicken, and cooling it before it becomes clear, *i.e.*, while it is still of milky whiteness. These inductors are made of filter paper or of single thick drawing paper, and extend from the lateral openings or windows about one-third the distance between the two windows in a circular direction. The outer edges of the inductors are arranged on a circle a little smaller than the revolving disc. At the end of each inductor and upon the opposite sides of the glass are pasted pieces, *d*, of gilt paper, which project into the window, and when dry are serrated, the points of the teeth being on the centre line of the windows.

In front of the revolving plate, B, two combs or collectors, E, are supported upon glass columns having wooden bases and tops. These combs are made of three-eighths inch brass tubing, the two pieces being fitted together and fastened with soft solder. The points, which are simply bank pins, are driven into holes in the brass tube three-eighths inch apart. The inner ends of the tubes forming the combs are soldered to brass ball buttons; the outer ends are inserted in wooden balls, from which wooden screws extend backward to receive the deeply grooved wooden nuts, F, which hold the edges of the apertured disc, A. The points of the combs each cover a space 2½ inches long, or about equal to the width of the paper inductors. Care should be taken to avoid bringing the inner ends of the combs nearer together than is absolutely necessary, and the outer point should be at least one-eighth inch from the periphery of the revolving plate. The points should be as near the face of the revolving glass as possible without touching. The combs are clamped in place by wooden screws in the wooden tops of the glass standards.

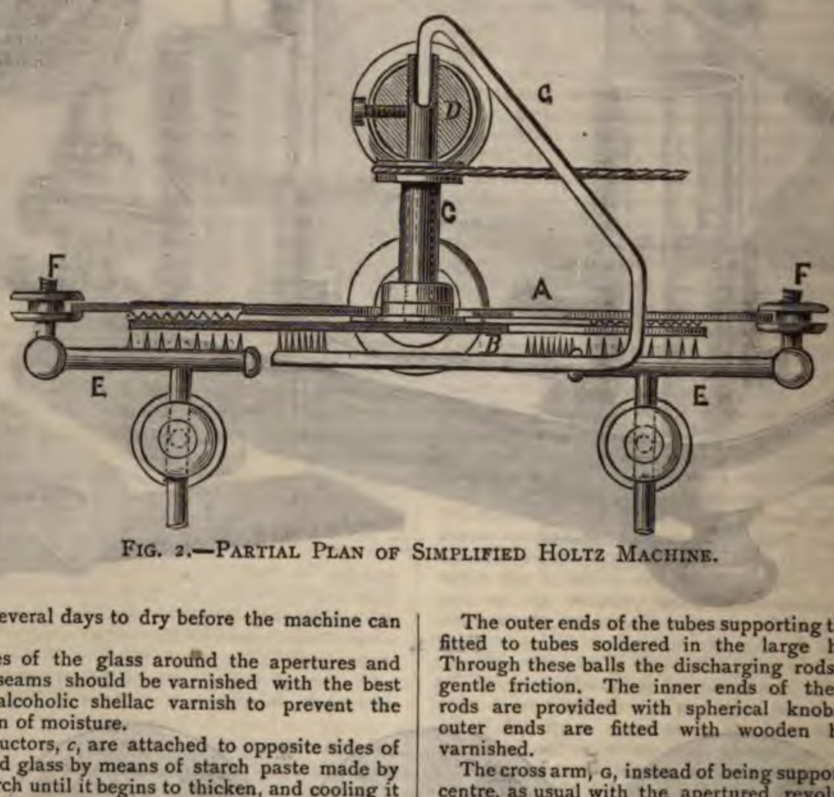


FIG. 2.—PARTIAL PLAN OF SIMPLIFIED HOLTZ MACHINE.

The outer ends of the tubes supporting the combs are fitted to tubes soldered in the large hollow balls. Through these balls the discharging rods slide with a gentle friction. The inner ends of the discharging rods are provided with spherical knobs, and their outer ends are fitted with wooden handles well varnished.

The cross arm, G, instead of being supported from the centre, as usual with the apertured revolving plate, is elongated and bent so as to enter the rear end of the tube which forms the bearing for the sleeve, C. It is split to create friction in the tubes to retain it in position, and in addition to this the screw which holds the tube in the post, D, passes through a hole in the tube and bears against the extension of the cross arm.

The free end of the cross arm is carefully rounded, and the pins correspond in number and position to those of the combs, E. The cross arm, when the machine is in use, is placed opposite the ends of the paper inductors, as shown in the illustration.

The lower edge of the apertured plate, A, rests in an adjustable support on the table.

The base of the machine is 13 inches wide by 14 inches long, with an extension 9 inches long for receiving the standard of the driving pulley, which is made adjustable on the table to tighten the belt, the table being slotted to receive the screw projecting from the standard, and the foot of the table answering as a nut to clamp the standard in any desired position. The pulley on the sleeve is 1½ inch in diameter, and the driving pulley is 6 inches in diameter. Almost any kind of belting will answer, but a gut string is preferable.

To complete the machine two condensers or small Leyden jars are required. These may vary in size; in the machine shown they are 2½ inches in diameter and 6 inches high, and are covered on the inner and outer side with tin foil to within 3 inches of the top, the starch paste before mentioned being used to fasten the foil. The uncovered portion of the jar is varnished with shellac. If jars of the desired form and proportion are not attainable, bottles may be readily cut by means of a hot curved rod of iron about one quarter inch in diameter.

The condensers are placed outside the glass columns under the tubes that support the combs, and a small chain hanging on each tube touches the tin foil lining of the jar.

The outer coatings of the jars are connected by a small brass chain lying on the table. The plate, A, should be placed about three-sixteenths of an inch from the plate, B, and it must be turned so that the edge of the windows to which the gilt paper is attached is exactly opposite the teeth of the combs, E.

To charge the machine the ends of the discharge rods are brought into actual contact, and a piece of vulcanite, a quarter of an inch thick, 4 inches wide, and 10 or 12 inches long, is rubbed with a catskin, a piece of flannel, or a piece of silk, and applied to one of the paper inductors. At the same moment the machine is turned toward the gilt paper points. A strong smell of ozone and an increased resistance to turning are the first indications of the successful charging of the machine. Now by slowly separating the discharge rods the spark will pass over an increased distance until it is fully 6 inches long. To produce the silent discharge all that is required is to remove the chain on the table from one of the jars. No special directions are required as to the management of the machine. A dry atmosphere is favourable to its action, and it must be kept free from dust. Air currents interfere with its operation; therefore it should be used in a room with the doors and windows shut.

I have so far described only one form of apertured plate. In (3) is shown a form in which the disc has a central portion, 1⅜ inches wide, removed and the two parts are connected by glass strips, *a a* and *b b*, cemented in the manner already described. When this form of plate is used the combs must be inclined to correspond to the direction of the edges to which the gilt paper is attached. (5) shows the usual form of plate, which requires the aid of the glass cutter, as the holes cannot be readily made by one unused to operations of this kind.—*Scientific American.*

PREPARATIONS are being made at Penzance for the landing of the shore end of the new independent cable between the Cornish coast and America.

TELEGRAPHIC APPARATUS IN USE IN THE BRITISH POSTAL TELEGRAPH DEPARTMENT.

XXXII.

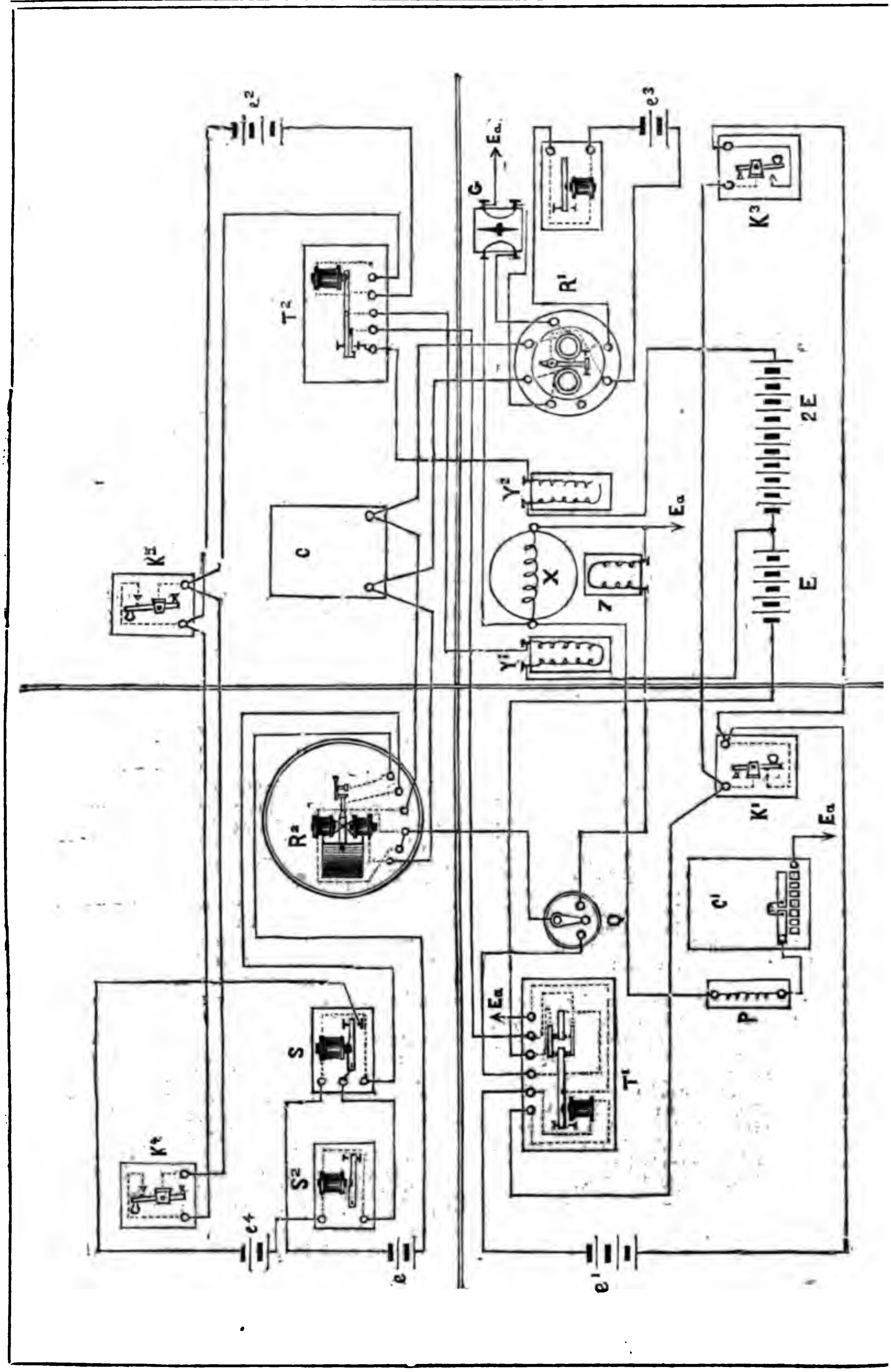
THE QUADRUPLEX SYSTEM.—(*Continued.*)

FIG. 130 shows the general arrangement of the apparatus at each station on a quadruplex circuit: R^1 and R^2 are the relays which are used to respond to the changes in the currents produced by the action of the transmitters, T^1 and T^2, at the corresponding distant station.

R^1 is a Post-Office standard relay (Article V., March 15th, 1880) which responds to the working of the double current transmitter at the distant station. This relay acts independently of the strength of the current, that is to say, it responds to reversals whether they be weak or strong, and it is therefore not influenced by the action of the transmitter, T^2, at the distant station. R^2 is a "compound" polarised relay, shown in general view by fig. 131, which responds only to an increase in the strength of the currents, whatever their direction, and responds therefore to the action of the transmitter, T^2, at the distant station. The principle of its action is shown by fig. 132.

The tongue, r, is placed directly in the centre of the field of the electro-magnet operating it. It is so adjusted by means of the springs, n and n^1, that it is not affected by the weak reverse currents sent by the transmitter, T^1. The screw stops, p^3 and p^4, regulate the play of the tongue; p^4 limiting the movement of the lever, N, in one direction, while p^3 limits the movement of r in the other direction. When r is in its normal position it is in contact with lever, N, whilst N is in contact with p^2; the local circuit of e through the non-polarised relay, S, is thus completed, and the armature of the latter is drawn down. But when r is moved by a current in either direction, so as either to break itself away from N, or to break N away from p^2, then this circuit is broken, the armature of S rises, and completes the local circuit of S^2, the reading sounder. The proper tensions of the springs, n and n^1, of course vary with the condition of the line, and they are kept so adjusted that while r responds to every current sent by T^2, it is not affected by those sent by T^1. It will be noticed that whenever the line current is reversed, and the tongue, r, is moved from one side to the other, a momentary short circuit through e is formed; but this change of position is facilitated by the large condenser, C, and the movement of the tongue is so rapid that the electro-magnet of the "uprighting sounder," or relay S, has not time to become magnetised, so that the period of the short circuit is not felt. If a simple neutral relay were used it would act independently of the direction of the current, but it would fall back, and be again attracted when currents were reversed, thus causing a break or click in the local circuit. This is not the case, however, with Mr. Gerritt Smith's relay.

Fig. 133 shows the different parts of the contacts of the relay. The contact, p^2, is permanently fixed and cannot be altered; p^4 and p^3 are adjustable and are ivory tipped.


T²
R¹
G
K³
K²
C
X
7
Y¹
Y²
E
2E
R²
K¹
C¹
Q
P
T¹
S
S²
K⁴
e
e¹
e²
e³
e⁴
Ea

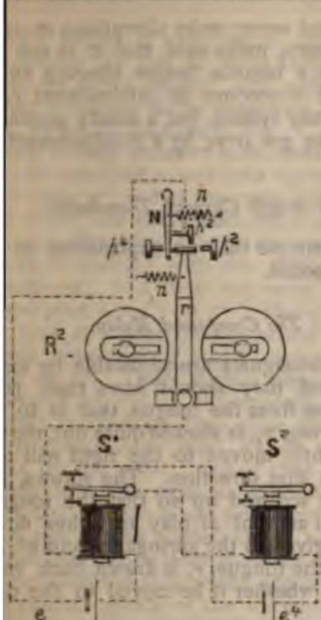


FIG. 132.

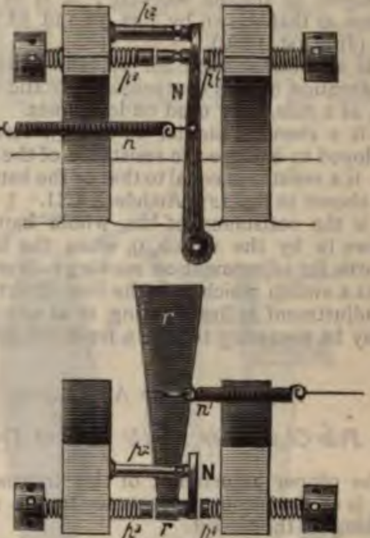


FIG. 133.

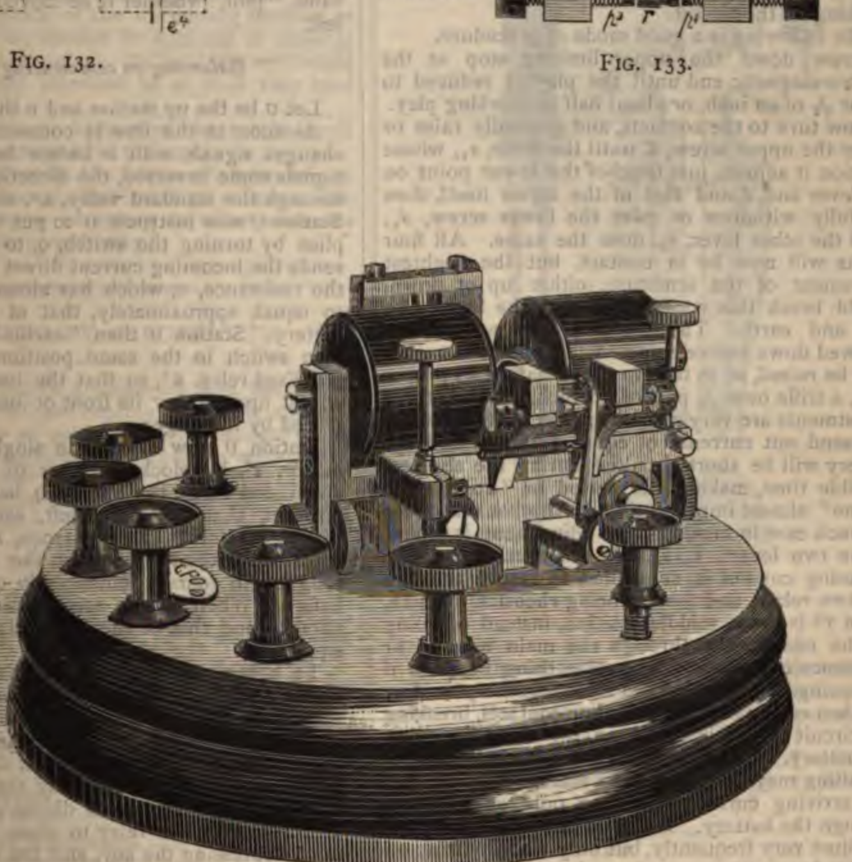


FIG. 131.

C[1], in fig. 130, is a condenser which is used for compensating the static charge on line as usually employed in duplex working; it is of the same pattern as that shown by figs. 56 and 58 in Article XII. (July 1st, 1880).

P is a rheostat used for adjusting the quantity and duration of this compensating static discharge. It is, as a rule, only used on long lines.

X is a rheostat, similar to fig. 55, Article XII., employed to balance the resistance of the line.

Y[1] is a resistance equal to that of the battery, 2 E,* also shown in fig. 127, Article XXXI.

Z is the resistance of the whole battery, 3 E, thrown in by the switch, Q, when the line is put to earth for adjustment on starting to work.

Q is a switch which puts the line direct to earth for adjustment at first starting, or at any time that it may be necessary to take a fresh balance.

ADJUSTMENT OF APPARATUS.

The Pole Changer or Double Current Transmitter.

The proper adjustment of this transmitter (fig. 128) is of the utmost importance to the successful working of the circuit.

The following is a good mode of procedure.

Screw down the upper limiting stop at the electro-magnetic end until the play is reduced to about $\frac{1}{32}$ of an inch, or about half its working play.

Now turn to the contacts, and gradually raise or lower the upper screw, d, until the lever, s_1, whose position it adjusts, just touches the lower point on the lever end, t, and that of the screw itself, then carefully withdraw or raise the lower screw, d_2, until the other lever, s_2, does the same. All four points will now be in contact, but the slightest movement of the armature, either up or down, would break this contact, and put the battery to line and earth. The limiting stop which was screwed down before commencing operations must now be raised, so as to give the armature its proper play, a trifle over $\frac{1}{32}$ part of an inch. When these adjustments are very carefully made, the transmitter will send out currents of equal duration, and the battery will be short-circuited during the shortest possible time, making the period of "no current to line" almost imperceptible. Another reason for so much care in making these adjustments is this:—If the two levers, s_1, s_4, are too much apart, the incoming current is compelled to return through the two relays and the balancing rheostat to earth, when T[2] is in the middle position, instead of going by the nearer way through the main battery, or resistance equal to it. The same thing happens if the springs are adjusted too close together, for they are then rocking between the line contacts, breaking the circuit of the line, and unduly short-circuiting the battery. By ordinary care the period of short-circuiting may be reduced to almost nothing, and the arriving current will then only go to earth through the battery. It should not be necessary to re-adjust very frequently, but only when putting on a new transmitter, or after cleaning the points when they have become dirty.

If the circuit is working well it is advisable to let it alone, and never make alterations at random. If a fault appears, make sure that it is not on the line, and take a balance before altering anything. Nothing will overcome an intermittent earth or contact with any system, but a steady partial earth may always be got over by a re-adjustment of the balance.

* It is found that the large battery need not be greater than 2 E.

The Single Current Transmitter.

This is so simple that no explanation of its adjustment is needed.

The Compound Relay.

The electro-magnets are adjustable by means of checknuts, and they should have their poles at equal distances from the tongue, that is to say, so that if the spring, n_1, is slacked quite out, the tongue on being slightly moved to the right will tend to move over in that direction. The screws, p^3 and p^4, should be screwed up so that the tongue will have an equal amount of play in either direction. The tension given to the springs, n^1 and n^2, should be such that the tongue, r, is drawn back with the same "pull," whether it be moved to the right or left.

Balancing on commencing to work.

Let U be the up station and D the down station.

As soon as the line is connected, station U exchanges signals with D before balancing. If the signals come reversed, the direction of the current through the standard relay, R[1], must be reversed. Station U now instructs D to put to earth; D complies by turning the switch, Q, to the right, which sends the incoming current direct to earth through the resistance, Z, which has already been adjusted to equal, approximately, that of the entire main battery. Station U then "earths" by placing his own switch in the same position, and adjusts his polarised relay, R[1], so that the tongue will remain at rest upon either its front or back stop, when so placed by the finger.

Station U now closes the single current transmitter, T[2], by blocking either of the keys, K[3], K[4], down, and turns the switch, Q, back to its original position, that is, to the left, sending the entire battery to line. The resistance, X, should now be adjusted, without touching the keys, until the tongue will remain indifferently on either stop as before. When this is accomplished, the line resistance and that of the balancing rheostat will be equal.

To obtain the electro-static balance, station U transmits dots or dashes by means of T[1], at the same time altering the capacity of the condenser, C[1], until it neutralises the discharge which takes place after each signal. When the discharge cannot be entirely neutralised by the condenser, that is, when a little too much discharge from the condenser causes the relay to close the local circuit upon depressing the key, and too small a discharge from the condenser causes the same defect upon opening the key, it is better to leave the excess in, and tone it down or retard it by means of the rheostat, P. The balance of this relay insures that of R[2] without further precaution.

Finally, station U again turns switch, Q, to the right, putting the line to earth through resistance equal to his entire battery; and station D proceeds to obtain a balance in the same way, having accomplished which he apprises U.

Station U then requests D to send V's from T^1, leaving T^2 open and at rest: the signals are received at U on relay R^1, and at the same time the springs, n and n^1, of the compound relay, R^2, should be pulled up sufficiently to hold the tongue at rest in the central position with the uprighting sounder circuit closed. D is then requested to leave T^1 at rest, and send A, B, C's on T^2. These signals should be received at U upon the compound relay, R^2, only. D is then requested to hold T^1 down, and continue to send on T^2. These signals should also be received upon R^2, but in the opposite direction, and R^1 should at the same time close its own local circuit. D should now send V's on one side, and A, B, C's on the other; and if they come without breaking, the pole changer at D is properly adjusted; but if there is any tendency to break up or kick on the R^2 side (called the B side), it may be assumed that the battery is either too weak or is short-circuited too long at the opposite end.

The contact points of the uprighting sounder or non-polarised relay should be adjusted as close as those of an ordinary relay. Its local battery should also be frequently attended to, as it is very hard worked.

It is a good plan to disconnect the B side locals when closing the circuit for the day.

With a little practice the whole of these adjustments may be done in five minutes or even less, for it is not always necessary to alter even the springs of the compound relay.

SOLDERING BY ELECTRICITY.

THE engraving shows a soldering iron heated by the electric current, and capable of melting all kinds of solders, such as gold and silver solder, which have heretofore required a blowpipe to melt them. It may also be used for the more fusible solders employed in making tin ware. Now that the electric current is distributed so generally and is used for all manner of purposes, it seems quite practicable to employ it for soldering.

Figs. 1, 2, and 3 show one form of electric soldering iron, fig. 1 being a perspective view, fig. 2 a section showing the switch fcr controlling the current, and fig. 3 a detail view of the switch button. Figs. 4 and 5 are views of a modified form of the device. In figs. 1 and 2 the electric conductors extend through and project beyond the handle, and embrace a piece of platinum or other material offering sufficient resistance to the passage of the electric current to become heated more or less according to the strength of the current. One of the conductors is separated near the upper end of the handle, and bridged by a button made partly of electrical conducting material and partly of insulating material, so that by turning the button the circuit may be completed or broken as circumstances may require. The device shown in figs. 4 and 5 is on the same general principle, the only difference being that the handle is split lengthwise, and the two portions are pressed apart by a spring. When apart to their fullest extent a hook attached to one of the conductors touches the other conductor and short-circuits the current in the handle. When the two halves of the handle are pressed together the current passes through the refractory point.

When the point is heated to incandescence the tool may be used for melting either silver or gold solder. For melting soft solder the heat may be less intense.

This invention was recently patented by Mr. C. E. Ball, of Philadelphia, Pa.—*Scientific American.*

ON the 25th ult. the western gable of the new Board School in Orange Street, Southwark, was struck by lightning and hurled to the ground. Fortunately no one was in the building at the time.

STONE'S IMPROVED HELIOGRAPH.

A VERY simple addition has recently been made to Major Macgregor's Ekowe Pocket Heliograph (TELEGRAPHIC JOURNAL, October 15th, 1880) by Mr. W. Stone, the constructor of the instrument. In the original apparatus the movement of the mirror for producing the flashes was effected by the direct

action of the hand. Mr. Stone's improvement consists in adding a small key, by the depression of which the mirror is moved through a small angle, and which can be worked like an ordinary Morse key. This addition is shown by the figure, which is self-explanatory.

CANADIAN TELEGRAPHY.—The Montreal Telegraph Company was organised in 1847 with a capital of £15,000. It had 500 miles of poles and wires and nine offices. It has now a capital of £500,000, 12,700 miles of poles, 21,500 miles of wire, and 1,674 offices. The number of telegrams sent over the line in 1880 was over 2,000,000; and its earnings for the year were £137,000. Within the same period Montreal has increased from 50,000 to 150,000, and now that a contract for the railway to British Columbia (over 2,600 miles) has been sanctioned by the Canadian Parliament a still more rapid increase in telegraphic business appears to be generally anticipated throughout the Dominion.

Notes.

MESSRS. DAVID MOSELY AND SONS, telegraph engineers and india-rubber manufacturers, of Manchester, inform us that they have succeeded, after experiments extending over upwards of twelve months, in finding and adapting for telephonic transmitters a material which will replace carbon with advantage. What the substance is has not been stated, but it is said to possess greater conductivity than any other non-metallic body, carbon not excepted, and a greater variation of resistance under variations of pressure than carbon. The new transmitter, the inventors state, will be found to excel the existing carbon arrangements. The material is said to be harder and therefore more durable than carbon. Patents for the invention have been applied for in various countries.

PROFESSOR TYNDALL is delivering a course of six lectures on Paramagnetism and Diamagnetism at the Royal Institution, Albemarle Street. The lectures commenced on Thursday, April 28, and will be continued every Thursday up to June 2.

THE electric railway is now laid down in the grounds of the Crystal Palace.

THE Manchester, Sheffield, and Lincolnshire Railway station, and that of the Midland, at Sheffield, are to be connected with the Telephone Exchange on the 1st of June. Eight hundred and sixty-eight purely business messages passed through the Sheffield Telephone Exchange on a single day last week. The total for the week was 4,400.

AN Italian journal states that Signor Manet whitens the albumen of blood by means of the electric light. In general, 24 hours suffice to give complete decolouration.

THE New York Electrical Society, recently formed, now numbers over 200 members.

MESSRS. LUND AND BLOCKLEY, clock and watch manufacturers, 42, Pall Mall, have recently applied their synchronising system to the Ludgate Hill platform clock of the Chatham and Dover Railway, by which it will be set to true time by an electric current from Pall Mall at 10 a.m. daily. They have also applied to the clock a novel automatic arrangement of their own invention, by which, at two minutes to 10 a.m. daily, the current will ring a warning bell, couple up and block against false currents two ordinary working telegraph lines, one in use from Victoria to Ludgate Hill, with intermediate stations, and the other from Kentish Town to Waterloo, passing through Ludgate Hill and jointly worked by the Chatham and Dover, the London and South Western, the Great Northern, and the Midland Railways. At 10 a.m. Messrs. Lund and Blockley's standard clock in Pall Mall, through a line—also automatically joined up with the Victoria and Ludgate line by a clock in the telegraph office at Victoria—will send an electric time-current of two seconds' duration, giving the time to these different railways. The current will set to true time—minutes and seconds—the clock at Victoria, the clock at Ludgate Hill, and a local standard for the use of the Great Northern Railway at King's Cross. Immediately upon the termination of the two seconds' time-current the three lines will be automatically re-established as

distinct lines for their ordinary telegraph purposes. No false current can by any possibility actuate the clocks, nor during the rest of the twenty-four hours can the clocks interfere with or be interfered with by the ordinary operations of the circuits. The principle of Messrs. Lund and Blockley's system is that of dropping a small weighted lever exactly at the hour, this lever grips the minute hand and sets it exactly at the hour division on the dial. The weighted lever is brought back in position by the going weight of the clock between each hour, and is released at the hour by an electro-magnetic detent.

MESSRS. BARRAUD AND LUND, of Cornhill, have devised an ingenious system of automatically testing and reporting the condition of the time wires by which their system of synchronising clocks is carried on. Their "fault-finder" for main lines is an alarum, and a series of indicators representing any number of trunk lines; so long as the various time signals are duly transmitted no indication is made, but failing any one of the trunk lines to receive its hourly signal, five minutes afterwards the alarum is rung, and a number is dropped indicating the particular line in default. This is the first time, we believe, that any instrument has been devised for making a telegraph line, absolutely broken down, report its own breakage. The "fault-finder" for branch lines indicates twice a day whether such lines are in working order, such indication from any number of branches being nevertheless transmitted over the single main trunk.

THE TELEGRAPH IN JAMAICA.—The postal telegraph service in the island of Jamaica comprises 32 stations, and employs 35 female operators. There are about 470 miles of wire now in use, which completely encircle the island, connecting all places of sufficient importance to require telegraphic facilities. The lines are under the superintendence of Mr. H. C. Wilson, an experienced telegraphist, who was first employed with the old Electric and International Telegraph Company, in England, subsequently serving three years in Egypt, and three years or more under the Western and Brazilian Company, at Pernambuco and Bolivia, about fourteen years in all. Mr. Wilson has superintended the construction of the lines, the opening of the offices, and the teaching of the operators. The lines are worked on the open circuit system, using Morse sounders and Siemens relays.

IMPROVED INCUBATOR.—An improved incubator, which regulates its temperature and shifts the eggs automatically at regular intervals, has recently been patented in America. It is provided with a series of longitudinal cloth hammocks or egg receivers, attached to end pieces pivoted to rigid supports and to movable bars, which are automatically moved so as to shift the eggs at regular intervals by suitable levers controlled by clock-work. The gas or oil cock of the flame of the boiler for heating the incubator is controlled by means of a pair of electro-magnets connected with a battery, and with a metal thermometer provided with an adjustable scale, so that the temperature of the incubator is regulated automatically.

A RECENT experiment by Professor Marangoni seems to prove that moist air cannot be regarded as an electrical conductor. A vessel of water heated over a lamp gives off steam through a bent tube passing to a bell jar through stoppers in each vessel. The bell jar, supported in an inclined position, thus gets filled with moist air. A small, fully-charged Leyden jar is pushed (the upper half of it) into the bell jar, and kept there four or five seconds. On removal it is found completely discharged. But that this discharge is due to a layer of water formed by condensation on the inserted jar, and superficial conduction by this layer, appears if the jar, before charging, be passed several times through the flame, so as to heat it to about 100° C. Repeating the experiment, the jar then suffers no apparent loss by remaining five seconds in the moist air; on withdrawal it will give a spark as long as when not submitted to the moisture. The hot state of the insulating surface prevents the condensation that occurred in the other case.

THE aldermen of New York have passed over the mayor's veto, the Ordinance giving the Edison Electric Lighting Company permission to lay tubes in the streets. The company will proceed immediately to introduce its new electric lamps in the offices in the business portion of the city around Wall Street. Wires have already been put into forty buildings. The Company will compete with the gas companies by charging the same rates. If the latter reduce, the Edison Company will also reduce, and, it is stated, are prepared to go lower than the gas companies can.

MESSRS. WILSON AND CAMMELL, of Dronfield, are making preparations for lighting their extensive steel and iron works with the electric light.

M. D'ABADIE gives an account of an instance of lightning unattended with thunder, which he witnessed in Africa, December 1, 1845. A mist, which filled a little valley close at hand, was illuminated by a sheet of flame, fainter at its margins and not extending to its utmost limits.—*Comptes Rendus.*

ON THE VOLTAIC CONDUCTIVITY OF HEATED GASES.—M. R. Blondlot.—Gases are generally considered incapable of transmitting the current furnished by a battery of several elements, except when raised to redness, as observed by M. E. Becquerel (*Annales de Chimie et de Physique*, ser. iii., vol. 39, p. 355). The accuracy of Becquerel's experiments has been called in question, and the author has, therefore, re-examined the entire question. He has demonstrated that gases become conductive at temperatures much below redness, even at 60—70° C. Any agitation of the air prevents the manifestation of the phenomenon.—*Comptes Rendus.*

ON THE INTERNAL DISCHARGES OF ELECTRIC CONDENSERS.—By M. E. Villari.—On discharging a strongly charged battery there is produced in its interior a characteristic sound. The glass of the jars on the margin of the coatings is brightly illuminated, and there is a disengagement of heat, as shown by the insertion of a suitably arranged air thermometer. There is consequently, in addition to the ordinary external discharge of the jar, another in its interior, which takes place along the sides of the condenser where not coated. The author has arrived at the following conclusions:—The heat developed by the internal discharge may be neglected in case of slight discharges, but beyond certain limits it becomes manifest and increases very rapidly with their strength; thus the first means of augmenting the internal heat is to make use of jars charged to a very high potential. The internal discharge is sensibly increased if the external spark is taken between two small balls, of 20 to 30 millimetres in diameter, and it is lessened by nearly one-half if the spark strikes between one of the balls and a point. The internal discharge is augmented

for one and the same charge if we diminish the internal coating of the jar, and it is lessened if the coating is increased. The internal discharge diminishes to zero if the resistance of the exterior circuit is much increased. It is, other things being equal, a little stronger if the internal coating consists of mercury. —*Comptes Rendus.*

AT a meeting of the Royal Society of Edinburgh, held on the 18th ult., Sir William Thomson, on taking the chair, congratulated the society on the presence of Professor Helmholtz among them, and said he had the still greater pleasure of announcing that the Professor had agreed to give them a paper that evening. Professor Helmholtz, who was received with applause, stated to the society the results of certain later experiments which he had made in working out his theory of electrolytic convection—experiments which, he said, had succeeded better than his former ones had done. He had entered upon his experiments on account of certain objections that had been made to Faraday's electrolytic law, in connection with experiments which showed that a very feeble galvanic current could be kept up by moderate electromotive force between platinum plates dipped in a slightly acidulated solution, even if the electromotive force of the battery was not sufficient to decompose water. He had found in his earlier experiments that the only effect of the current was to absorb oxygen given off from the atmosphere, and to form a new portion of water, and that the whole electrolytic effect was not to decompose water and to produce a new quantity of elements —hydrogen and oxygen—but only that on the surface of one plate of platinum oxygen was collected and taken away from the surface of the other; he had, therefore, called these currents electrolytic convection. It was not really a decomposition, but only a transport of one of the products of electrolytic decomposition from one plate to another. In his later experiments he had got rid of the atmospheric oxygen by inclosing the whole electrolytic fluid in a solid glass vessel. As a result, he had found that with the smallest electromotive force, down to the one-hundredth or one-thousandth of a Daniell's cell, there was no trace of a continuous current passing through the voltameter, but a strong deflection for a moment, which, after some oscillations of the magnet became zero, although the electromotive force was still acting. If the circuit was broken, a contrary current of the same duration as the direct was observed. Sir William Thomson, in speaking on the paper, stated that Professor Helmholtz's theory of electrolytic convection formed quite an era in electrolytic chemistry. A communication was afterwards read by Prof. Blyth "On the Causes of Sounds produced in an Ordinary Microphone Receiver." For simplicity it was assumed that what takes place at the receiving end when sounds are reproduced is mere make and break. When two carbon points touch each other we may consider them as two fine wires. A spiral of platinum wire through which a current could be sent was inclosed in a tin box. When an interrupted current was sent through the wire the sounds from a tuning-fork were heard coming from the box. Mr. Preece (TELEGRAPHIC JOURNAL, vol. viii., p. 205) suggests that wires conveying currents are heated and cooled, and as the variations in the strength of the current are small compared with the strength of the current itself, the expansion and contraction vary in the same ratio as the condensation and rarefaction of the air particles conveying the sonorous vibrations. If the air contracts and expands, its volume will be made bigger and less. If the volume is actually made bigger and less the volume as a gas will as a whole be made less or more. To find if there was expansion and contraction coal gas was allowed to enter a receiver, and by means of a small jet and revolving mirror the action of the current on the flame when the tuning-fork was set in action was observed. Not the slightest up and down movement of the flame could be detected, the flame being continuous, whether joined up or not. The action in water was next tried. The sounds of the tuning-fork were distinctly heard, but mixed up with a little hissing noise. The water, however, could not be seen moving; there was a slight elevation of the water, due to the heating of the wire going through it. Mercury was afterwards tried. When an interrupted current was sent the sounds could be heard, but accompanied by dull sounds. A source of fallacy suggested itself here, and Prof. Blyth constructed a telephone in the stem of which a cylindrical hole of one inch diameter is cut. The diaphragm is of tin. In the centre of the diaphragm there is a copper wire, which dips in mercury. The mouthpiece is of the ordinary pattern. When an interrupted current was sent, the diaphragm works up and down, and the sounds are perfectly heard. Whether or not the sounds produced in a microphonic receiver are due to condensation and rarefactions, it was impossible to discover any increase of volume.

A PUBLIC meeting has been held at Lerwick to protest against the Postmaster-general's refusal to give direct telegraphic communication with the mainland. An influential deputation has been sent to London to make further representations and urge a reconsideration of the decision.

GREENOCK steamboat quay has been lighted experimentally by electricity—four lamps are used. The result is entirely satisfactory.

FRANCE has now three electrical periodicals, a new one having appeared during the last month under the title of *L'Electricien.* We notice among the writers in the first number the names of MM. A. Niaudet, Gaston Tissandier, E. Mercadier, C. M. Gariel, Dr. de Cyon, and also that of M. Hospitalier. The latter occupies the position of *secrétaire de la rédaction.* It is intended that the paper shall be published on the 1st and 15th of each month. The price per copy is one franc.

AT a meeting of the London Gas Light Company held on the 13th ult., Mr. Robert Rawlinson, one of the directors, expressed his belief that the movement as to the electric light would put gas manufacturers on their mettle, and make them produce the article of the best quality, and to see that the best fittings were used. There ought to be no jealousy between the companies and the consumers. It must be borne in mind that the electric light was useful for certain purposes. He was not so ignorant or so prejudiced as to believe that it would go backward; on the contrary, he thought it probable that the electric light would accomplish considerably more than they had yet seen; but, at the same time, he did not believe that it would seriously interfere with the profits of gas making if gas makers were true to their own interests.

HERR FRIEDRICH SIEMENS, of Dresden, has devised a gas-burner of remarkable intensity. He maintains a high temperature by introducing air previously heated by the waste heat of combustion. A burner of 500 candle-power has been produced, and it is stated the quantity of gas used is small. Seeing that combustion is quickened by hot air, we cannot understand this.—*Athenæum.*

SHEETS numerously signed of the national petition in favour of telegraphic communication between the light-ships around our coasts and the shore have been forwarded to Mr. Hobbs, of Ramsgate, by the Mayor of Gateshead and other gentlemen in various parts of the kingdom. In a pamphlet addressed by the philanthropic promoters of this reform to mayors, yacht and sailing clubs, and persons interested in mercantile pursuits, attention is directed to the loss of the *Indian Chief* on the Long Sand, when only eleven lives were saved out of twenty-nine; to the recent wreck of the Dutch fishing smack on the same spot, when only one out of seven was saved; and to the fatal loss of the *Nymphæa* on the Sunk Sands with all hands. These instances are considered to be striking proofs of the importance of this movement. In the second case the one sailor saved had been clinging to the mast for nearly four days.

MR. J. SLATER on Monday, the 25th ult., read, before the Institute of British Architects, a paper on the subject of "Electric Lighting as applied to Public Buildings."

ACCORDING to a report from Vienna the first step towards the practical application of the invention of telephones has at last been made in the Austrian capital. The Vienna Local Telegraph Company has applied for and has been granted a concession to establish telephonic communication in the city. In granting the privilege the Government has made two conditions—firstly, that the subscription should be as low as possible; and secondly, that telephonic communication should in certain cases come under control, as is the case with telegraphic communication. The first condition has been fulfilled already by the company intending to limit the amount of subscription to from 100 to 140 florins a year.

M. J. B. DUMAS, the distinguished *savant*, gave a lecture recently in Paris to the National Industry Encouragement Society on the experiments of M. Camille Faure and M. Reynier for rendering electricity portable. They claimed to have solved the problem of storing up electricity in a reservoir so as to transport it and employ it for illuminating or other purposes, and M. Dumas spoke very highly of their investigations.

ON THE CONSTRUCTION OF PHOTOPHONIC SELENIUM RECEIVERS.—By M. E. Mercadier—These receivers are formed by taking two bands of brass, $\frac{1}{10}$ millimetre in thickness, 0·01 metre in width, and varying from 4 to 5 metres. They are separated by two bands of parchment paper of about 0·15 millimetre in thickness. The whole is rolled up in a spiral as tightly as possible, and fastened by means of two pieces of wood held by two screws. The two surfaces are smoothed off with the file. The apparatus is heated in a sand-bath, or on a thick sheet of copper placed above a Bunsen burner, to the point at which selenium begins to melt. A stick of selenium is then rubbed over the surface, forming a layer, as thin as possible, of the characteristic slatey tint mentioned by G. Bell. These receivers are continuous, and their construction is extremely easy. They may be polished with the file, and any defect is very easily repaired. They may be made with a very small surface, which permits them to be readily placed in a complex apparatus. They have the same properties as the ordinary discontinuous receivers, plane or cylindrical. The surfaces may be preserved by covering them with a sheet of mica, or more simply by giving them a coat of lac varnish. They may have a very variable resistance, from 8,000 to 10,000 ohms up to 200,000, without their ceasing to act well. Hence results the possibility of placing in their circuit, which contains the battery, a sufficiently large number of telephonic receivers, the resistance of which may, without inconvenience, reach up to 200 ohms, which enables the photophonic effects to be heard by a great number of persons at once. One of these receivers, of 7 centimetres surface, gives in a Gower telephone of 235 ohms resistance, sounds which can be heard at the distance of two or three metres.—*Comptes Rendus.*

M. A. TRÉCUL in a communication to the Paris Academy of Sciences, describes a curious electric phenomena which he witnessed August 25, 1880. A very brilliant luminous body of a pale yellow colour, almost white, issued from a dark cloud. It had a well-defined outline and was of a longish form with conical ends. It disappeared almost instantly, re-entering the cloud, but left behind it a small portion of its substance which fell vertically, like a heavy body, as if under the sole influence of gravitation, leaving behind it a luminous train, and finally breaking up into fragments. No sound was heard either at the moment of its departure or of its division.—*Comptes Rendus.*

ON CAUSES WHICH INTERFERE WITH TELEPHONIC TRANSMISSION.—M. A. Gaiffe.—Having remarked that telephones transmit along with speech sounds of an unknown origin, the author has undertaken experiments in order to find out if the causes of these sounds are not those which oppose telephonic communication at great distances. To eliminate all possible sources of error, the following arrangement was adopted. A line of 20 metres was laid on the floor of several rooms, all the doors of communication being closed. It was connected at one end to a pair of telephones by means of flexible conductors, designed to arrest sounds which might communicate themselves mechanically along the metal to the telephones. The circuit was completed between these conductors by another flexible wire, on the path of which was an interruption-pedal, rendering it possible to cut the circuit without changing at all the nature of the communications between the line and the telephones, and to prove that the sounds heard had an electric origin. The operator acted at the other end of the line which was not connected, directly or by induction, with any electric generator. He observed that the current produced by the friction of two wires of the same kind or of different kinds and that produced by closing a pressure screw were heard in the telephones. It is easily understood that when suspended, telegraph wires serve for telephonic transmission; this cause may occasion much trouble, since these lines are formed of pieces of iron wire connected to each other and to the stretchers by ligatures, more or less perfect, which are in a state of constant agitation. But this cause of failure may be removed by soldering the wires instead of tying them. Unfortunately, there is another cause: the currents due to the influence of the vibrations themselves. To verify this hypothesis, the author placed in the circuit, at the end opposite the telephones, a rod of iron 1·50 metre in length, and connected to the system by supple conductors. This rod was struck sometimes tranversely and sometimes longitudinally with a hammer. The sounds occasioned by the blows were distinctly reproduced by the telephones with their peculiar characters. This experiment, if repeated with copper or brass rods, gave merely negative results. It seems that the phenomenon is only produced as an effect of the vibrations occasioned in the wire. Future experiments must decide whether it is due to a molecular change which the metal undergoes or to a

peculiar action. If, as it is probable, the vibrations caused by the wind act upon the lines of iron wires like the blows upon a rod, it appears difficult to correspond at great distances with the existing means of transmission, till a method has been found of causing the telephones to speak by the aid of electric action so powerful that the currents arising in the line itself cease to be an appreciable cause of disturbance.

AT the meeting of the Société de Physique, March 18th, M. Bailiehache exhibited a printing telegraph. The manipulator is an inverter, each letter being successively produced by a positive or negative current, and the impression is effected by the interruption of the current on a band of cloth, which advances by the space of one letter when the current is re-established by the transmission of the following letters. With this apparatus the Crédit Lyonnais sends daily the course of the Stock Exchange simultaneously to its seventeen branch offices at present in activity.

MEETING, APRIL 1ST.—M. Mercadier exhibited the results of his researches on radiophony produced by means of selenium. M. Mascart exhibited a registering electrometer and a magnetometer. M. de Mersanne exhibited a voltaic arc electric lamp, moved by clockwork and fitted to serve for a long time. The system is arranged for alternative currents, and the regulation is obtained by means of a derivation coil and an electro-magnet, which keeps the arc constant by reacting on the clock movement which governs the advance of the carbons.—*L'Electricien.*

ON March 30th experiments were made in the hall of the Athenæum in order to show that the electric light, especially on Werdermann's system, is easily adapted to all the requirements of theatres.—*L'Electricien.*

THE ECONOMY OF THE ELECTRIC LIGHT.—By M. A. VANDERPOL.—On a circuit of Siemens machines with alternating currents (hitherto these lamps have only been constructed to work with currents of this kind, though they could give the same results with continuous currents) as many as twenty luminous foci have been placed, though practically the number of ten is not exceeded. A current which commonly serves for four Jablochkoff candles may supply seven or eight Siemens lamps of equal intensity. When in one and the same circuit the number of lights is increased, for instance, to nine or ten, the intensity of each is diminished, though the total yield of light is increased. The motive force exerted is also increased. Whilst we must allow at least one horse-power for Jablochkoff candle, the force necessary for a Siemens burner is half a horse-power. As to the question of expense, the author shows that the carbons used in the Siemens lamps are 10 millimetres in diameter and 20 centimetres in length, which, taking account of waste, gives an hourly expense per light of 12 to 15 centimes, and gives light for 5 to 6 hours. The luminous intensity, according to the number of lamps, is = 25 to 50 gas jets, and averages = 35. Taking account of first cost of the plant, and calculating 600 hours of light yearly, the expense, including the motive power, is about 33 centimes per hour. But 33 centimes is the cost of 8 gas jets, not including the interest on first outlay. In most workshops it is possible to substitute one electric lamp of this intensity for 8 gas jets. This is, therefore, the present state of the question: the electric lamp gives four times more light for an equal expense.—*Le Technologiste.*

SASSERATH'S IMPROVEMENTS IN TELEPHONES.—The author (German patent, No. 11,477) uses instead of a metallic membrane one of mica, wood, or other non-conductive matter, which he connects with the inner pole of a horse-shoe magnet, terminating in a metallic tongue, by means of an interposed cube of caoutchouc. This cube is fixed in the centre of the membrane, and transfers the vibrations of the latter to the metallic tongue. The other pole of the magnet is provided with a wire coil, the nucleus of which is prolonged up to the metal tongue, so that both poles are within the magnetic field. If the membrane of the transmitter is set in vibration, such vibrations are communicated to the metal tongue, and according to the extent or strength of its vibrations the magnetic force and the strength of the induction current vary. These fluctuations in the strength of the current produce in the receiving telephone a corresponding variation in the strength of the magnetism in the coil, and the tongue and membrane of the receiving apparatus are thrown into corresponding vibrations and reproduce the sounds uttered. The pressure of the caoutchouc cube upon the membrane is regulated by a screw acting upon the magnet, in opposition to which a spring tends to withdraw the magnet from the membrane.—*Electrotech. Zeitschrift.*

LEHMANN'S TELEPHONIC APPARATUS.—(German patent, No. 11,595.)—This invention is based upon the fact that a carbonaceous or metallic powder in a loose condition is almost a non-conductor of electricity if the latter is not of strong tension, whilst in a compressed or at least strongly compacted state it becomes a relatively good conductor. The patentee constructs an apparatus to increase the action of sound in the telephone. He utilises this property of such powders by inclosing them in elastic receptacles and introducing them along with a common telephone into the circuit of a battery in the following manner:—To the centre point of the membrane of a telephone there is soldered, pointing downwards and exactly vertical to its plane, a well-polished steel needle, tapering off in an accurately conical manner. The point of this needle pierces a stopper of soft caoutchouc as near as possible to the membrane, and containing in a cavity, opening downwards, a powder of charcoal and silver, containing about 75 per cent. of carbon and 25 of silver. This stopper is inclosed in a brass case, which allows it a certain room for expansion and which is closed from below by a brass screw, the conical end of which projects into the powder and exerts a certain pressure upon it. This screw is connected with one of the polar wires, while the other is connected with the metallic membrane. When the latter vibrates, the needle penetrates alternately into the powder and is drawn back, alternately compressing and loosening it. In this manner the inventor seeks to effect a rapid alternation in the conductivity of the powder corresponding to the vibrations of the membrane, and thus to produce variations in the strength of the current, which are to produce an exact reproduction of the sounds in the receiving apparatus.—*Electro-techn. Zeitschrift.*

IN a paper recently read by M. Bartelous before the scientific section of the Syndical Union of Brussels, it was stated, on the evidence of statistics, that with the most perfected systems serious fires were reduced to 4 per cent.; with systems of telegraph lines, but without alarms, they still reached 17 per cent.; while without telegraph offices they reached 27 per cent. M. Bartelous recommended that the telegraph offices now open be authorised to transmit alarms of fire free of cost to the sender, and that this use of the offices be indicated by placards.

AT the close of the year 1880 the lengths of telegraph lines in various parts of the world were as follows: United States, 171,103 miles; Russia, 56,170 miles; Germany, 41,431; France, 36,970; Austria-Hungary, 30,403; Australia, 26,842; Great Britain, 23,156; British India, 18,209; Turkey, 17,085; and Italy, 15,864.

THE summer course of the Technical Science Classes of the City and Guilds of London Institute will commence in May. The course will include "Electrical Instrument Making," introductory and advanced, and the "Electric Light," by Professor Ayrton. The following are the subjects dealt with:—

ELECTRICAL INSTRUMENT MAKING. INTRODUCTORY COURSE.—*Construction of Statical Electrical Apparatus.*—Meaning of an electrified body, conduction, insulation. Leakage through the insulating material, surface leakage, laws of. Leakage in artifically dried spaces, modes of effecting such artificial drying. *Insulating supports*, how they are usually made, their faults, how they should be made. Positive and negative electricity. Equal quantities of the two kinds always produced simultaneously. *Quantity* and *density* of electricity, mode of measuring. Induction. *Electroscopes*, ordinary method of constructing, faults usually existing, proper method of constructing. Electric *potential*, analogy with level or pressure. Electroscopes indicate differences of potential. Electromotive force. Density varies over a conductor, potential remains constant. Amount of work stored up in a charged body. Electric *capacity*, measurement of; Leyden jars. *Specific inductive capacity*, measurement of; condensers, practical detail of construction. Effect of time-of-charging on the capacity of a condenser. Absorption of charge, residual charge. Leakage from a Leyden jar, how to reduce to a minimum, resistance of different substances to conduction or to disruptive discharge. Production of electricity. *Frictional machines*, theory of their construction, usual defects, how some of the defects may be remedied. Source of energy in the so-called frictional production of electricity. *Induction machines*, Varley's, Thomson's, Holtz's, Toepler's; details of construction, mode of using, superiority to frictional machines. Electricity produced by a machine compared with that produced by a voltaic cell. *Electrometers* measure difference of potentials. Peltier's, Bohnenberger's and Thomson's electrometers; details of construction, possible improvements in construction. Absolute, portable, and long range electrometers. Use of high electromotive force machines for telegraphy, cause of failure. Possible future employment of the Holtz machine for the electric transmission of power to long distances. Insulation of gases at various pressures. Practical use of results, &c.

ELECTRICAL INSTRUMENT MAKING. ADVANCED COURSE.—*Resistance Coils.*—Resistance of a wire depends on its length, diameter, material, purity, hardness, temperature, age, &c. Choice of material and size of wire. Winding coils, insulation of; proper method to insulate ends. Testing coils; temperature corrections. Variation of temperature, correction in different parts of the same coil of wire. Permanency of resisting power; annealing by time; artificial annealing of finished coils. Baking coils. Exterior of coil-box; objection to highly-polished ebonite; insulation of. Suitable coils to form a set. Plugs, revolving arms, slides. Thomson's and Varley's sliding coils, principle of; construction of circular forms. Standard coils, the ohm, connection with the theoretical standard, construction and testing of. Defect in standard coils as commonly made. Hermetically-sealed coils. Method of constructing cheap accurate resistance coils; coils for very strong currents such as are produced by dynamo-electric machines, &c.

Condensers.—Construction of; materials employed. Necessity of drying the insulating compounds. Injury done by overheating a dielectric. Modes of purifying paraffin, shell-lac, &c. Capacity of a condenser depends on the area of the conducting coatings, the thickness, nature and temperature of the dielectric. Practical methods of measuring the capacity and insulation of condensers. Adjustment of capacity. Effect of residual charge, how to diminish. Manufacture of condensers to be used with very high electromotive forces. Absolute condensers with calculable capacity, construction and practical use of, &c. Artificial cables, use and construction of. Tests of capacity; insulation of the dielectric, and resistance of the conductor. How to adjust each. Outside of condenser boxes; proper mode of making the terminals, &c.

Induction Coils.—Fundamental principle of. Use of iron wire core. Time of magnetising and demagnetising of iron. Quantities of electricity induced on making and breaking the primary circuit equal to one another, but the electromotive forces of the two induced currents very unequal. Proper resistance to give to the primary and to the secondary coils. Mode of winding the wire to secure high insulation, and to obtain maximum effect; shape of coils; actual results obtained with ring-shaped core. Contact makers; usual forms modes of varying speed of making and breaking the circuit. Improvements that can be effected by using automatic current reversers. Use of condenser with primary circuit, and with secondary circuit. Experimental determination of the efficiency of induction coils. Employment of induction coils in electric lighting, and in chronographs for measuring very small intervals of time. Duration of the spark discharge.

Telephones.—Principle of small recurrent effects. Early forms of telephones. Improvements introduced by Bell. Dead-beat effects produced by lightness and rigidity of iron membrane. Reason for using a flat coil wire. Edison's telephone, use of induction coil, details of construction. Ader's simple wire telephone, principle of. Gower-Bell telephone, construction of the horse-shoe permanent magnet, and kind of steel employed. Hughes' induction balance, theory of its action; mode of construction. Connection of its indications with the resistance and self-induction of the substance experimented on.

THE ELECTRIC LIGHT.—Heat produced by an electric current. Meaning of an electric current and the direction of flow. Current proportional to chemical decomposition. *Electromotive force.* Ohm's law. Analogy, and want of analogy of an electric current with a stream of water. Heat produced when a resistance or an electromotive force is overcome.

The Electric Arc.—Temperature very great, and yet heating of surrounding space small, reason of this. The electric light, and electric furnace, reason of present economy compared with former want of economy. Resistance of arc, opposing electromotive force set up in the arc. Dead-beat absolute galvanometers for measuring strong currents. Horse-power expended in the arc. Measurement of light. *Photometers*, Bunsen's, Ayrton and Perry's, &c. "Arc horse-power measurer." Amount of light per horse-power expended in the arc for different currents, thicknesses of carbons, and length of arc, &c. *Electric lamps*, principles of the more important, Foucault's, Serrin's, Duboscq's, Siemens', Crompton's, &c. *Electric candles*, Werdermann's, Jablochkoff's. Efficiency of the various kinds. *Vacuum lamps*, Edison's, Swan's, Lane Fox's. Life of vacuum lamps. Current and electromotive force necessary to

maintain a given conductor at a given temperature. Relative economy of lighting by the arc and by incandescence. Combination of the two methods. *Carbons*, manufacture of, and resistance of different kinds. *English patents* regarding electric lighting. *Generators* of electric currents; batteries, description of the more important and their defects. Great efficiency of constant batteries. High price per pound of fuel consumed. Direction in which improvements may be looked for in batteries. *Magneto and dynamo-electric machines*, fundamental principles of the more important, Wilde's, Holmes's, Siemens', Gramme's, Lontin's, &c. Constant current, improvements to be made in the commutators, reverse current producers. Measurement of efficiency of current generators, force dynamometers, Alteneck's, Ayrton and Perry's; actual results practically obtained. Connection between the electromotive force set up, the current generated, the resistance in circuit and the speed. How the results are effected by using a separate exciter. Coercitive force of the revolving iron armature. Saturation of inducing magnets, direction in which improvements may be looked for in magneto and dynamo-electric machines. Proper employment of the electric light, possibility of subdivision. *English patents* regarding dynamo and magneto-electric machines.

It is a matter of importance that it should be known that the above exhaustive course is open for an almost nominal fee to female as well as to male students.

ON THE CHANGE OF VOLUME WHICH ACCOMPANIES THE GALVANIC DEPOSITION OF A METAL.—By M. E. Bouty.—In previous notes I have established, 1st, that the galvanic depositions experience a change of volume, from which there results a pressure exercised on the mould which receives them; 2nd, that the Peltier phenomenon is produced at the surface of contact of an electrode and of an electrolyte. Fresh observations have caused me to believe that the two phenomena are connected, and that the first is a consequence of the second. The Peltier effect can clearly be proved when the electrolysis is not interfered with by energetic secondary actions, and particularly with the sulphate and nitrate of copper, the sulphate and chloride of zinc, and the sulphate and chloride of cadmium. For any one of these salts it is possible to determine a value, I, of the intensity of the current which produces the metallic deposit such that, for all the higher intensities the electrode becomes heated, and such that it becomes cold for less intensities. I will designate this intensity, I, under the name of *neutral point of temperatures*.

The new fact which I have observed is, that in the electrolysis of the same salts it is always possible to lower the intensity of the current below a limit, I', such that the compression produced by the deposit changes its direction, that is to say, instead of contracting the metal dilates in solidifying. This change, although unquestionable, is sufficiently difficult to produce with sulphate of copper. It is necessary to employ as a negative electrode a thermometer sensitive to $\frac{1}{500}$th of a degree, and to take most careful precautions to avoid accidental deformations of the deposit; but the phenomenon can be observed very easily with nitrate of copper, the sulphate of zinc, and the chloride of cadmium. There is, therefore, a *neutral point of compression* in the same cases where there is a neutral point of temperatures. With the salts of iron, nickel, &c., for which the neutral point of temperatures cannot be arrived at, there is also no neutral point of compression; and the negative electrode always becomes heated, and the deposit obtained is always a compressing deposit.

I have determined, by the help of observations made with ten different current strengths, the constants of the formulæ which I have explained elsewhere, and which gives the apparent excess, y, of the thermometer electrode compressed by the metallic deposit in terms of the time, t, during which the metal was depositing:

$$(1) \qquad y = \frac{A t}{B + t}.$$

The constant, A, is proportional to the variation of volume of the unit of volume of the metal. The values of A, without being exactly regular, are sufficiently well represented within practical limits by the formula:

$$(2) \qquad A = -a'i + b'i^2,$$

of the same form as the expression E:

$$E = -ai + bi^2,$$

of the heating of the thermometer electrode. Further, every cause which affects the coefficients, a or b, also affects in the same way a' and b': such causes being the greater or less dilution of the solution, the nature of the salt, &c. It is therefore impossible not to be struck by the direct relation of the thermic and mechanical phenomena of which the negative electrode is the origin. The following is the explanation which I offer: The thermometer indicates the mean temperature of the liquid just outside it; this temperature is not necessarily that of the metal which incloses it. The current, propagated almost exclusively by the molecules of the decomposed salt, does not act directly to cause a variation in the temperature of the dissolving molecules; these change heat with the molecules of the electrolyte, which should be in general hotter than those, when a heating is noticed and colder when a cooling is observed. Suppose it is found, in the first case, that the metal, at the moment when it is deposited, is hotter than the liquid, and, consequently, than the thermometer; it becomes colder immediately after the deposit, and consequently contracts; the deposit is compressed. The reverse is the case when the metal is colder than the liquid; the deposit then dilates. If this hypothesis is correct, the excess, T, of the temperature of the metal over the liquid which surrounds the thermometer should be proportional to the contraction, A, represented by the formula (2), and the neutral point, I', of the contraction corresponds to the case where the temperature of the metal is precisely equal to that of the liquid.

It might be expected, perhaps, from the foregoing, that $I' = I$; this would take place if the excess of temperature of the metal, measured by the contraction, were rigorously proportional to the heating of the liquid, for then the two quantities would be null at the same time. Careful experiment proves that this is not the case. The sulphate of copper gives compressing deposits on a thermometer which is undoubtedly cooling; chloride of zinc of a density 200 can give expanding deposits on a thermometer which is heating. There is, therefore, no proportionality; but it must be remarked that the temperature of the metal which is deposited does not depend only on the quantities of heat disengaged in an interval of molecular thickness which is infinitely small compared with the thickness of the layer, of which the variations of temperature are registered by the thermometer. There is nothing surprising, therefore, that the two variations of temperature, according exactly with one another, do not follow identically the same laws.—*Comptes Rendus.*

New Patents—1881.

1550. "Means for protecting magnetic needles from local attraction." J. S. GISBORNE. Dated April 9.

1577. "Improvements in electric telegraphs, parts of which improvements are also applicable to other similar purposes." J. HOPKINSON and A. MUIRHEAD. Dated April 11.

1596. "Electric lamps." A. W. REDDIE. (Communicated by H. Sedlaczek and F. Wiknlill.) Dated April 12.

1613. "Improvements in electrical signalling and tell-tale apparatus, chiefly designed for the use and supervision of watchmen." W. R. LAKE. (Communicated by J. T. Campbell.) Dated April 13.

1624. "Electric telegraphs." A. MUIRHEAD and H. A. C. SAUNDERS. Dated April 13.

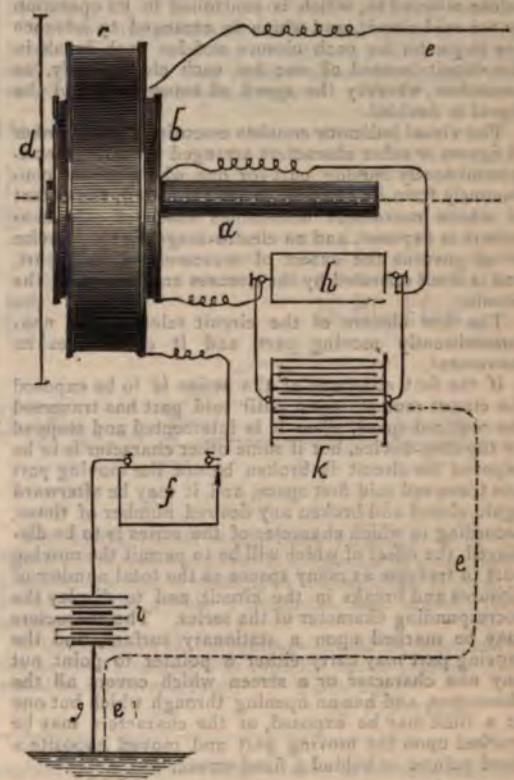
1630. "Improvements in the treatment of ores and compounds containing metals for the separation of the metals therefrom, and the production of electricity and in the apparatus employed therein, and the mode or means of regenerating the agents employed in such treatment." J. H. JOHNSON. (Communicated by N. E. Reynier.) Dated April 13.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1880.

3324. "Electric machines." CHARLES GODFREY GÜMPEL. Dated August 16. 2d. Relates to the construction of dynamo-electric and magneto-electric machines for producing electric currents, or of electro-dynamic machines for conversion of electricity into motive power, and consists chiefly in a special form of rotating armature and a special manner of winding upon it the insulated wire. (*Provisional only.*)

3473. "Apparatus for transmitting and receiving signals." ARTHUR FRENCH ST. GEORGE. Dated August 27. 10d. Relates to novel methods of arrangement of apparatus to be used for the purpose of acoustical telegraphy by means of electricity, and it has for its objects the attainment of greater simplicity and efficiency than in apparatus for similar purposes of the kind ordinarily heretofore constructed and used. *a* is a metallic bar surrounded with an internal coil, *b*, and an external coil, *c*, of insulated wire; *d* is a vibrating diaphragm; *e* is the main line wire, through which the current is transmitted round the external coil, *e*, by any suitable form of transmitting apparatus, *f*, in any desired part of the circuit, the current then passing by the wire, *g*, back through the earth or through a return wire; *h* is a resistance apparatus, the amount of resistance of which can be varied and adjusted as desired, which is placed in the circuit of the inner coil, *b*. *k* is a condenser arranged so that the current through the inner coil, *c*, may be made to pass as desired to it, or through the resistance coil, *h*. The disturbing currents induced in the main line, and which it is desired to suppress or neutralise, pass through the outer coil of the receiving telephone and induce corresponding currents in the inner coil. These induced currents produced as described in the inner coil pass in a direction opposite and opposed to that of the currents passing through the outer coil.

By this means and by suitably adjusting the variable resistance apparatus a certain point can be attained at which the disturbing currents are to a certain extent suppressed or neutralised by the opposing action upon the metallic bar or core, caused by the opposing currents in the two coils surrounding such bar or core, and which bar or core actuates the diaphragm, and consequently the objectionable noises are neutralised. The condenser shown at *k* is not specially necessary for neutralising "induction" noises, but it is found to be necessary for the efficient working of the apparatus upon long lines of any considerable inductive capacity



or other unfavourable electrical conditions upon which retardation of electric currents transmitted is found to take place. The object of arranging the condenser in connection with the inner coil of the receiving telephone, as shown, is to cause an electrostatic induction between the two coils, *b* and *c*, when a current is received in the outer coil, *c*, from the line, *e*.

3494. "Electric lamps, &c." ST. GEORGE LANE FOX. Dated August 28. 6d. Relates to the lamps described in THE TELEGRAPHIC JOURNAL for March 15, page 97.

3505. "Electric signalling telegraphs, &c." WILLIAM CLARK. (A communication from abroad by John Van Dussen Reed, of New York.) Dated August 28. 10d. Relates partly to electric signalling telegraphs and partly to indicators for use therewith, which point out or display one figure or other character of a series, or one character of each of two or more series, and its object is to produce a telegraph and indicator which can be operated with extreme rapidity and which shall be accurate and reliable, displaying always at the indicator the figure or character intended without confusing it with other characters.

The invention is particularly adapted to fire and burglar-alarm telegraphs, and hotel annunciators, and to telephones, although applicable also to other forms of electric signals.

An electric circuit is formed, which includes a bat-

tery, one or more sending stations, and one or more receiving stations. This circuit may be normally either open or closed. Each sending station is provided with mechanism for closing and breaking this circuit a certain number of times in rapid succession whenever it is operated to send a signal, and each receiving station is provided with the indicator hereinbefore referred to, which is controlled in its operation by the said circuit, and which is arranged to advance one character for each closure and for each break in the circuit instead of one for each closure only, as heretofore, whereby the speed of transmission of the signal is doubled.

The visual indicator consists essentially of a number of figures or other characters arranged in series, a non-intermittently moving part (or one which moves continuously from its starting to its stoppage), the extent of whose movement determines which of said characters is exposed, and an electro-magnetic stop-device which governs the extent of movement of said part, and is itself operated by the closures and breaks of the circuit.

The first closure of the circuit releases the non-intermittently moving part, and it commences its movement.

If the first character of the series is to be exposed the circuit remains open until said part has traversed the required space, when it is intercepted and stopped by the stop-device, but if some other character is to be exposed the circuit is broken before the moving part has traversed said first space, and it may be afterward again closed and broken any desired number of times, according to which character of the series is to be displayed, the effect of which will be to permit the moving part to traverse as many spaces as the total number of closures and breaks in the circuit, and to display the corresponding character of the series. The characters may be marked upon a stationary surface, and the moving part may carry either a pointer to point out any one character or a screen which covers all the characters, and has an opening through which but one at a time may be exposed, or the characters may be marked upon the moving part and moved opposite a fixed pointer or behind a fixed screen.

3637. "Lighting cities by electricity." PHILIP MIDDLETON JUSTICE. (A communication from abroad by Henry Curtis Spalding, of the City of Boston, America.) Dated September 7. 6d. Has for its object the lighting of towns and cities by means of electricity with economy, and in such manner as to cast the least possible shadows from the buildings. In order that a town or city may be properly lighted the atmosphere must be flooded with such a quantity of light irradiated in many directions as to reduce to a minimum or practically prevent the casting of shadows; this object is accomplished by the employment of groups of electric lights, each group consisting of a number of lights massed together, supported at a high level, say one hundred feet above the houses, by means of towers of from 100 to 200 or more feet in height, according to the height of the buildings, and by arranging the towers in triangular groups of not less than three towers, whereby the rays of light cast by the electric lights of one tower are caused to cross angularly those cast by the remaining towers; each light tower supports a reflecting lantern containing electric lights.

3670. "Regenerating the fluids of galvanic batteries, &c." ALEXANDER MELVILLE CLARK. (A communication from abroad by Emile Reynier, of Paris, France.) Dated September 9. 4d. This invention consists in a process of regenerating the electrolytic fluids of galvanic batteries in which caustic soda or potash are employed, and of recovering the zinc hydrate which has become dissolved therein, by utilising the property of this oxide of being abundantly soluble in a concentrated caustic soda or potash lye, only slightly soluble in a weak lye, and insoluble in plain water. The process of treating the electrolyte of a battery in which caustic soda or potash is employed, and which has become charged with zinc hydrate by the working of the battery, consists essentially in precipitating the oxide of zinc by the addition of water, reconcentrating and decarbonating the liquid. The insoluble carbonate of zinc which may have been formed by the carbonic acid of the air, or by any carbonates that may accidentally be present with the caustic alkalies, is separated by decantation. To the liquid freed from the insoluble carbonate of zinc are added four to eight volumes of water, which precipitates the zinc hydrate, this precipitation being more complete the more dilute the solution. The zinc hydrate is decanted, collected, washed thoroughly, drained and dried, the dilute lye which has been drawn off is then evaporated and concentrated till it attains its original density. Any carbonic acid the liquid may still contain is eliminated by caustification with lime.

3734. "Appliance for signalling." ALEXANDER MAXWELL RITCHIE. Dated September 14. 6d. Relates to a new or improved construction of signalling appliance, ball, or shape, to be used by ships at sea, particularly as a distress signal, and for ships not under command, in compliance with the Merchant Shipping Amendment Act, but also applicable for storm warning signals on land, and for other signalling purposes. The new or improved signal appliance is specially designed to be readily collapsed, and thus occupy little space when stowed away as compared with ordinary ball signals. The invention consists essentially in forming the improved ball or shape of two hoops of iron, steel, or other rigid metal or material, fitted the one inside the other, and connected together by a swivelling pin on each side, so that the hoops may be either in one plane or opened out in planes at right angles to each other. These hoops are covered with canvas, sail cloth, or other similar material, stitched or otherwise fastened round the rim and extending across each to form a pair of discs, the one disc being complete, whilst the cloth of the other is sewed or attached to the former on either side at or near the axial line of the swivelling pins, so that the two discs can be collapsed to the flat state; and when there are several such balls used for signalling, these can be stowed away in less space than an ordinary ball of the same diameter. The swivelling pins are also formed with eyes outside for attachment to the hoisting ropes or halyards, and a clamp or catch is fitted loosely on one of the centre pins, and fitted with four prongs or other equivalent, which catch on either side of the hoops in their collapsed condition, and this pronged clamp is lifted and replaced to grip each of the hoops when opened out at right angles, and thus hold them firmly in this position, in which the ball or shape is hoisted as a signal.

3808. "Dynamo machines." FREDERIC GEORGE WILLATT. Dated September 20. 2d. An armature having four or more, but preferably six, blades, broad at the outer end and narrowing somewhat towards the centre, is cast in one solid piece. Each blade is wound in the same direction and coupled up so as to form north and south poles across the centre of the armature when in motion, and round the armature extends a stationary soft iron magnet composed of two parts, one acting as N. and the other as S., and preferably circular in form so as to fit round the armature and economise space. (*Provisional only.*)

Correspondence.

ROLLS' METHOD OF TELEPHONING BETWEEN BLOCK SIGNAL CABINS.

To the Editor of THE TELEGRAPHIC JOURNAL.

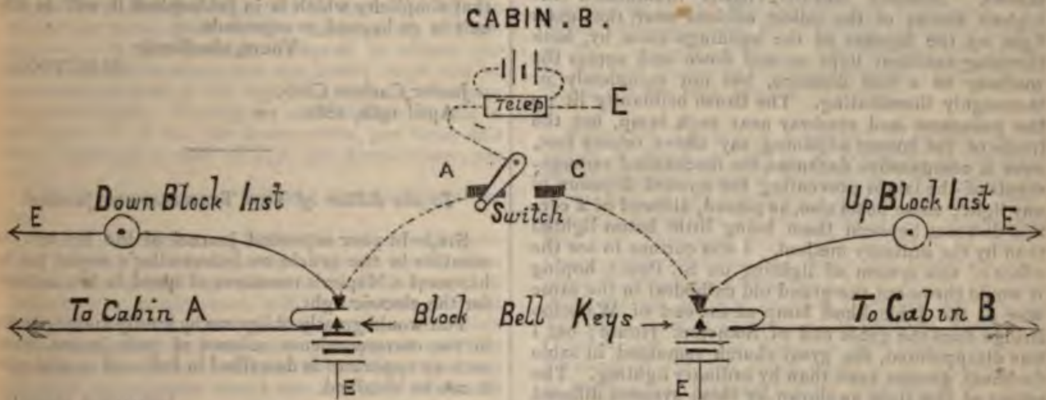
DEAR SIR,—I think it may be interesting to some of your readers if I detail the system I have worked out and put into practice for telephoning between block signal cabins.

The great obstacle to overcome was the high cost of the telephones (Gower-Bell) as compared with the more familiar single needle instrument. The advantages to be gained by the increased facility of verbal communication scarcely need mentioning.

By my method the difficulty is entirely surmounted, and a chain of telephonic communication may be established between block signal cabins at even less cost than the single needle system. All extra line wires, leading in wires (and the single needle battery) are saved by making the block wire do dual service, and the cost of a second telephone at each cabin, the expense of which might be prohibitory, is avoided.

The connections are very simple, and may be added by the lineman in half an hour. I give a plan of these beneath; the dotted lines show all that is additional for telephoning upon the existing block instrument connections.

The relative resistances with most forms of block instruments are such that no compensation is required, and difference in the signals upon introducing the telephone is quite imperceptible.



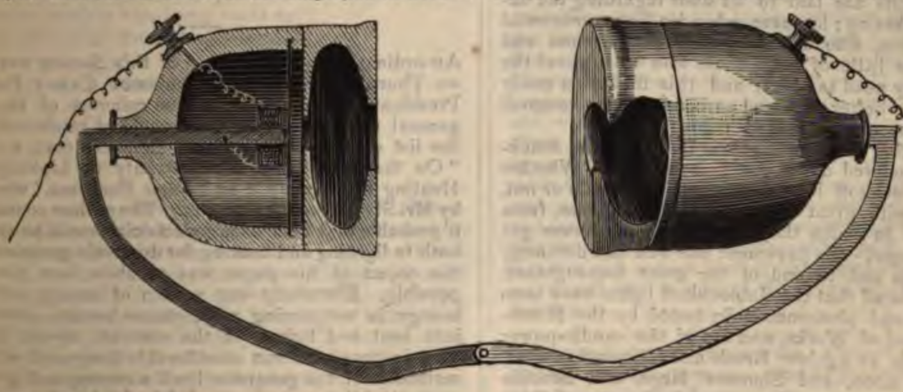
The switch stands indifferently turned to A or C. When either cabin requires to telephone to B the preconcerted number of beats upon the block bell is given; B reverses the switch if requisite, and receives the message.

If transmission of the message should be required it can be done *viva voce* with rapidity, but in practice this would be rarely necessary. Yours truly,

E. T. ROLLS.

To the Editor of THE TELEGRAPHIC JOURNAL.

DEAR SIR,—The difficulty experienced in listening to, and writing down, a telephonic communication when the ordinary form of apparatus is employed is well known, for as a rule both hands are employed in holding the two telephones or two ear tubes up to the ear, and consequently the writing down has to be effected by a second person. If one ear only is employed for listening, so that one hand can be at liberty to hold a pen, then the power of hearing is very considerably diminished. The apparatus of which I give a sketch enables two telephones to be secured to the ears, so that the hands of the listener are left free to write.



The mouth-pieces of the telephones are so shaped that they can be slipped over the ears and be held securely there; a metal bar connects the two instruments and lies against the nape of the neck and keeps the whole apparatus steady. I am, Sir, yours faithfully,

London, April, 1881. C. C. VYLE.

[An apparatus very similar to the foregoing was described and illustrated in the number of this journal for December 1st, 1878.—EDITOR TEL. JOUR.]

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—The remarks by the press generally regarding the electric lighting of the City are certainly favourable. Some give the palm to one system, some to another, the highest encomium paid being perhaps that regarding the Brockie light at the Cannon-street station. Electric light is, however, electric light, and the favourable progress of one system more or less reflects on all. In watching the general effect of the new light in the City, one was struck with the wide difference between the two systems now tried in the streets. Siemens' elevated lights illuminated the highest stories of the tallest edifices near, the lesser light up the façades of the buildings close by, both throwing excellent light up and down and across the roadway to a fair distance, but not completely or thoroughly illuminating. The Brush brilliantly lit up the pavement and roadway near each lamp, but the fronts of the houses adjoining, say above twenty feet, were in comparative darkness, the mechanical arrangements of the lamps preventing the upward diffusion of any light; these posts also, as placed, allowed of a certain distance between them being little better lighted than by the ordinary method. I was curious to see the effect of this system of lighting on St. Paul's, hoping it would throw out the grand old cathedral in the same way as the Jablochkoff lamp at the end of Waterloo Bridge does the gable end of Somerset House; but I was disappointed, the great church remained in sable darkness, greater even than by ordinary lighting. The colour of the light as shown by these systems differed considerably. The Brockie at Cannon-street station was more like the Jablochkoff on the Embankment, of a yellowish white; the Siemens a pale blue; while the Brush shone with a greeny blue tinge, no doubt owing to the excess in the copper vapour given off, and casting a rather cadaverous look on passers by. One thing the City lighting undoubtedly does, it demonstrates the considerable improvements of late in "regulator" lamps; but for an electric light for the streets, or where the supervision can be but very general, extreme simplicity is the desideratum. Now the first system practically tried was the Jablochkoff. It has stood two years, including three winters of great severity, on a most exposed and trying position; it would now, but for legal proceedings, be lighting Queen Victoria-street, City, though it needed not any trial to show its merits or its worth. Faults are laid to its door regarding the occasional flickering; however, when leading commercial establishments, who use it in their show-rooms and offices, make little of such, those who walk about the streets surely need say less; and this flicker is easily remedied by better prepared carbons and the removal of all extraneous matter from them.

After leaving the Brush lights in Bridge-street, Blackfriars, I wandered down the Embankment. Whether the old Jablochkoff lamps were on their mettle or not, they shone with great brilliancy, and with them, from the manner in which they are placed, one never got into a dark spot—the pavement was well and distinctly lighted from end to end of the great thoroughfare. It may be stated that the Jablochkoff lights have been thoroughly and photometrically tested by the Metropolitan Board of Works, and are of the candle-power of 265: this as against Brush and Siemens' smaller, said to be 2,000, and Siemens' large, and Brockie 6,000. I am not aware, however, whether any of these have been subjected to any crucial test as to light power. The Jablochkoff system as compared with all others, superior or inferior to it in light, possesses what no other has, viz., simplicity. Every other system depends upon some clock-work or other mechanical contrivance, with or without magnets, &c., to keep the poles at their proper distance, the Jablochkoff—nothing: simple as the placing of a taper in a candlestick and manageable by a child. When the battle of the lights is fought out and novelty ended, simplicity and economy become a desideratum, this invention of the Polish engineer, which has served our finest thoroughfare for two years, and well, will, so far as present practical working indicates, I opine, find itself, if not the only reliable system, at least at the head of a list which, to judge by appearances, seems likely to be steadily added to monthly. Mechanism can be improved, so can the purity of carbon manufacture, but that simplicity which is in Jablochkoff it will be difficult to go beyond or supersede.

Yours, obediently,

ELECTRON.

Junior Carlton Club.
April 19th, 1881.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—In your esteemed journal of the 1st inst. you mention in the article on Schwendler's report that he has used a Napier's measurer of speed in his machines for the electric light.

You would greatly oblige me by kindly making known in the correspondence column of your journal where such an apparatus is described in full, and at what price it can be obtained.

MORITZ KOHN.

Vienna, April 19th.

[Perhaps some of our readers will oblige with the desired information.—ED. TEL. JOUR.]

Proceedings of Societies.

THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.

AN ordinary general meeting of this Society was held on Thursday, April 14th, Professor CAREY FOSTER, President, in the chair. The minutes of the last general meeting having been read and confirmed, and the list of new and proposed members read, a paper "On the application of Electricity to Lighting and Heating for Domestic and other Purposes," was read by Mr. ST. GEORGE LANE FOX. The author considered it probable that before long electricity would be applied both to lighting and heating for domestic purposes, and the object of his paper was to show how this was possible. Electricity was a form of energy, and this energy in overcoming a resistance became converted into heat and light. If the external circuit of the electric generator was considerable compared with the resistance of the generator itself a corresponding large amount of the energy expended in driving the machine became utilised in the form of heat. This being the case, it could be shown that an indefinitely large number of electric lamps could be worked from central stations with a proportional cost of working.

In general principle his system was similar to that of gas lighting, viz., large mains extended from the

generators and smaller ones branched off from them to the lamps.

The lamps employed by him were on the incandescent principle, and possessed several peculiarities in their construction. The wires leading into the glass bulbs were rendered air-tight by passing through mercury chambers, the latter metal being kept in its place by a stopping of marine glue. The cost of the lamps was stated to be one shilling (for full description of lamp, see TELEGRAPHIC JOURNAL, March 15th). Mr. Fox said that there was nothing in the construction of the lamp that prevented its being indestructible. As regards illuminating power, this he estimated at 150 candles per horse-power if the temperature was not excessive. It was possible, however, to obtain 500 candles per horse-power, but the lamps could not be guaranteed to last at the high temperature necessary to give this light. Taking the consumption of coal in an engine at $1\frac{3}{4}$ lbs. per horse-power, per hour, this would represent a cost of $\frac{1}{10}$d. per horse-power, per hour.

In the discussion which followed the reading of the paper

Mr. R. E. CROMPTON said that the estimated expenditure of coal per horse-power as given by Mr. Fox was much lower than would as a rule be the case, but even taking a greater cost, still the expense, at least for arc lighting, was less than that for gas. Mr. Fox's method of regulating the speed of the dynamo machine by making the current control the throttle-valve, was one which no engineer would use, as the action would be highly irregular; the proper method to adopt would be to regulate the slide-valve gear, and this could only be done by a considerable expenditure of force, which the current could not give.

Professor AYRTON then explained the construction of his "Portable absolute galvanometer for strong currents." The new instrument, it was pointed out, was free from the defects which existed in those hitherto constructed. The instrument was of small dimensions and was dead beat in its action, the needle moving at once to its correct position.

Professor AYRTON then explained the action of "A new transmission dynamometer," invented by Professor Perry and himself.

In the discussion which followed the explanation

Mr. R. E. CROMPTON stated that an instrument similar to that described, but of better construction, had been used by him some years ago.

The discussion was then adjourned.

City Notes.

Old Broad Street, April 26, 1881.

THE INDO-EUROPEAN TELEGRAPH COMPANY (LIMITED).—The directors' report for 1880 states that the Company's revenue from all sources for 1880 amounted to £98,731 14s. 11d., showing an increase of £12,372 15s. The expenses were £46,463 8s., showing an increase of £672 16s. 7d. After charging £10,169 6s. 5d. percentage upon profits payable to Messrs. Siemens under their maintenance contract, taking credit for the balance brought over from last year, £748 18s. 1d., and deducting income-tax, there remains the sum of £42,362 7s. 1d. From this amount the interim dividend of £10,625 already paid has to be deducted, leaving a net balance of £31,737 7s. 1d. to be dealt with. The directors propose to declare a dividend for the last six months of 17s. 6d. per share, making, with the interim dividend already paid, 6 per cent. for the year, and a bonus of 10s. per share; both free of income-tax. Out of the balance of £8,362 7s. 1d., £7,500 is proposed to be added to the reserve fund, and £862 7s. 1d. to be carried to the credit of the current year. The Company is still pressing its claim against the Russian Government. For the benefit and encouragement of the officers and servants of the Company the directors will submit to the shareholders a proposal to enable them to introduce a system of assurance, endowment, or pension, not to entail in the aggregate a charge exceeding £1,000 per annum. This system has been adopted by all the leading telegraph companies. The Board have appointed Mr. Andrews managing director of the Company's affairs. The meeting will be held at the New Exchange Buildings, George Yard, Lombard Street, on the 28th April at 12 o'clock.

REUTER'S TELEGRAM COMPANY (LIMITED).—The report of this Company to be presented at the seventeenth ordinary general meeting of the shareholders, to be held at the Company's offices, 24, Old Jewry, London, states that the net profits for the year ending the 31st December last, after payment of current charges and deducting bad debts and rebate on unexpired subscriptions, amount to £8,278 16s. 8d., including £108 14s. 9d. brought forward from the last account. The usual interim dividend of $2\frac{1}{2}$ per cent. was paid in October last, and the directors now declare a further dividend of 12s. per share, equal to $7\frac{1}{2}$ per cent., free of income-tax, making a total distribution of 10 per cent. for the year. This will absorb £7,366 6s., and after adding £800 to the reserve fund there will remain a balance of £112 10s. 8d. to be carried forward. The directors have decided to recommend to the shareholders the establishment of an Insurance and Superannuation Fund for the officers of the Company, and a resolution will be submitted to the meeting authorising the directors, out of the receipts of the Company, to apply from time to time a sum not exceeding £300 a year for carrying out that object.

GERMAN UNION TELEGRAPH AND TRUST COMPANY (LIMITED).—The tenth ordinary general meeting of the shareholders in this Company was held on April 12th, at the Offices, Old Broad Street, under the presidency of Mr. H. Weaver. The chairman in moving the adoption of the report (published in our last issue), congratulated them on the highly satisfactory condition of the Company's affairs. The increase in the traffic had been very marked, and he had no doubt that the adoption of the word-rate tariff would cause a still larger increase. Their reserve fund stood at £15,615, and with the renewal fund amounted to £24,268, or about one-seventh of the capital. There was no reason to suppose that they would ever require to renew the cable from end to end, for it was in very shallow water, and in the event of a breakage could be easily raised and mended. Mr. H. G. Erichsen seconded the motion, and it was carried unanimously; and the retiring director and auditor having been re-elected, the meeting closed with a vote of thanks to the chairman and directors.

CONSOLIDATED TELEPHONE CONSTRUCTION AND MAINTENANCE COMPANY.—The applications for shares were, we understand, very large.

THE WEST COAST OF AMERICA TELEGRAPH COMPANY (LIMITED).—We are informed that telegraphic communication is now re-established with all the stations of this Company, between Valparaiso and Lima (Serena, Caldera, Antofagasta, Iquique, Arica,

Mollendo, Callao), and that messages will now be received at the various telegraph offices for transmission to any part of the west coast of South America.

COMPAGNIE FRANÇAISE DU TÉLÉGRAPHE DE PARIS À NEW YORK.—This Company's Brest-St. Pierre cable having been repaired, communication with America, &c., is re-established.

GREAT NORTHERN TELEGRAPH COMPANY OF COPENHAGEN.—At the annual general meeting held at Copenhagen, on the 12th April, 1881, F. Zahle, Esq., presiding, the chairman, C. F. Tietgen, Esq., after having in his introductory remarks referred to some points in the Company's history, and congratulated the shareholders upon the present prosperous state of the Company, reported as follows upon the Company's business generally:—Several of the European cables had suffered from interruptions, and, unfortunately, these had in some cases been of longer duration than ordinarily, owing mainly to stormy weather, which had prevented more speedy repairs. There had been a marked increase in both the extra-European and the European traffic. The increase in the latter was mainly owing to the introduction of the word-rate system adopted by the International Telegraph Conference held in London in 1879, and which took effect on the 1st April, 1880. As compared with 1879, the traffic returns for 1880 showed an increase of £28,000; on the other hand the expenditure had slightly increased. Also with regard to the laying of the new English-Norwegian-Swedish Cable, the shareholders could be congratulated. The cable had been laid from a point near Newcastle-upon-Tyne to Arendal in Norway, and from there to Marstrand, near Gothenburg in Sweden. The total length was about 522 nautical miles. It had been manufactured by the Telegraph Construction and Maintenance Company, Limited, and successfully laid by the same Company in September last. The Swedish and Norwegian Governments had agreed to extend the terms of all the existing concessions until the 1st January, 1911, and if it were considered that out of the Company's nine European cables six were landed in those countries, the prolongation of the Company's monopolies was of an importance which could not be overrated. In accordance with the resolution passed at the extraordinary general meeting of the 17th November last, the capital required for the new cable had been obtained by the issue of £100,000 5 per cent. obligations, redeemable within 20 years. These had been offered to the public by Messrs. C. J. Hambro & Son, in London, and the Private Bank in Copenhagen, and had readily been taken up at par. In consequence of this measure the reserve fund had remained intact; £64,113 17s. 10d. had been further invested on account of that fund, and the interest on the investments would now suffice to meet the interest payable on the new loan. The greatest event of the year for the Company had, however, been its connection with the extension of the telegraph system in China. At the request of the Chinese Government, the Company had, in July last, commenced a survey of the country between Shanghai and Tientsin with a view to the establishment of an overland telegraph service between those two places. On the completion of the survey a plan had been prepared by the Company for the construction of the line, and on the basis of this plan, which was approved by the Government, a contract had been entered into at Tientsin on the 22nd December last, between the Government and the Company. According to this contract the Company would have to supply all materials, instruments, &c., required for the construction of the line and stations, and the Company had also agreed to appoint engineers to superintend the work, which would be commenced on the 15th May this year. The route of the line, which would be of a length of about 1,000 miles, would follow the Grand Canal, and great facilities would thus be offered for the transport of the materials and the subsequent maintenance of the line. Besides this the Company had undertaken to appoint the necessary teachers for a College of Telegraphy which the Government had established at Tientsin. This line from Shanghai to Tientsin would be of the greatest importance for the development of telegraph undertakings in China, as the line would, no doubt, shortly be extended from Tientsin to Pekin, a distance of 80 miles, and thus connect this great capital and Tientsin, the commercial centre of North China, with the lines of the Company, and so with the whole world. As another event of the year, the directors would draw the attention of the shareholders to a contract entered into between the Imperial Russian Government and the Company for supplying and laying a cable of about 70 nautical miles from the eastern coast of Siberia to the Island of Saghalien. The cable had already been manufactured in London, and would be sent out by the Company's s.s. *Store Nordiske*, in order to be laid by that ship during the most favourable season of the year. Without discussion, the report was then unanimously adopted, the accounts were passed, and discharge given to the board of directors. The retiring director, Col. O. V. Hoskiær, R.D.E., was re-elected. The shareholders' auditors, His Excellency Admiral Bille, and A. Berner, Esq., were also re-elected.

The following are the final quotations of telegraphs:—Anglo-American, Limited, 58-58½; Ditto, Preferred, 87-88; Ditto, Deferred, 30½-31; Black Sea, Limited, —; Brazilian Submarine, Limited, 10¼-10¾; Cuba, Limited, 9-9½; Cuba, Limited, 10 per cent. Preference, 16½-17; Direct Spanish, Limited, 3¾-4¼; Direct Spanish, 10 per cent. Preference, 13-14; Direct United States Cable, Limited, 1877, 11⅝-11⅞; 6 per cent. Debentures, 100-103; Eastern, Limited, 9¾-10; Eastern 6 per cent. Preference, 12¾-13; Eastern, 6 per cent. Debentures, repayable October, 1883, 101-105; Eastern 5 per cent. Debentures, repayable August, 1887, 102-104; Eastern, 5 per cent., repayable Aug., 1899, 103-106; Eastern Extension, Australasian and China, Limited, 10⅝-11⅛; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 109-112; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 105-107; Ditto, registered, repayable 1900, 105-107; Ditto, 5 per cent. Debenture, 1890, 103-106; Eastern and South African, Limited, 5 per cent. Mortgage Debentures, redeemable 1900, 102-104; Ditto, ditto, to bearer, 102-104; German Union Telegraph and Trust, 11¼-11¾; Globe Telegraph and Trust, Limited, 6⅜-6⅝; Globe, 6 per cent. Preference, 12⅜-12⅞; Great Northern, 12¾-13; 5 per cent. Debentures, 103-106; Indo-European, Limited, 28½-29½; London Platino-Brazilian, Limited, 6⅛-6⅜; Mediterranean Extension, Limited, 2¼-2¾; Mediterranean Extension, 8 per cent. Preference, 9¾-10¼; Reuter's Limited, 11-12; Submarine, 270-290; Submarine Scrip, 2⅜-2⅝; Submarine Cables Trust, 99-102; United Telephone Company, —; West Coast of America, Limited, 4¾-5¼; West India and Panama, Limited, 2-2½; Ditto, 6 per cent. First Preference, 7-7½; Ditto, ditto, Second Preference, 6¼-6¾; Western and Brazilian, Limited, 8⅜-8⅝; Ditto, 6 per cent. Debentures "A," 104-108; Ditto, ditto, ditto, "B," 98-102; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 124-129; Ditto, 6 per cent. Sterling Bonds, 104-108; Telegraph Construction and Maintenance, Limited, 31-31½; Ditto, 6 per cent. Bonds, 107-110; Ditto, Second Bonus Trust Certificates, 4-4½; India Rubber Company, 19-19½; Ditto, 6 per cent. Debenture, 104-108.

THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. IX.—No. 199.

UPON THE PRODUCTION OF SOUND BY RADIANT ENERGY.

By ALEXANDER GRAHAM BELL.

(A Paper read before the National Academy of Arts and Sciences, April 21st, 1881.)

IN a paper read before the American Association for the Advancement of Science, last August, I described certain experiments made by Mr. Sumner Tainter and myself which had resulted in the construction of a "Photophone," or apparatus for the production of sound by light;* and it will be my object to-day to describe the progress we have made in the investigation of photophonic phenomena since the date of this communication.

In my Boston paper the discovery was announced that thin discs of very many different substances *emitted sounds* when exposed to the action of a rapidly-interrupted beam of sun-light. The great variety of material used in these experiments led me to believe that sonorousness under such circumstances would be found to be a general property of all matter.

At that time we had failed to obtain audible effects from masses of the various substances which became sonorous in the condition of thin diaphragms, but this failure was explained upon the supposition that the molecular disturbance produced by the light was chiefly a surface action, and that under the circumstances of the experiments the vibration had to be transmitted through the mass of the substance in order to affect the ear. It was therefore supposed that, if we could lead to the ear air that was directly in contact with the illuminated surface, louder sounds might be obtained, and solid masses be found to be as sonorous as thin diaphragms. The first experiments made to verify this hypothesis pointed towards success. A beam of sun-light was focussed into one end of an open tube, the ear being placed at the other end. Upon interrupting the beam, a clear, musical tone was heard, the pitch of which depended upon the frequency of the interruption of the light and the loudness upon the material composing the tube.

At this stage our experiments were interrupted, as circumstances called me to Europe.

While in Paris a new form of the experiment occurred to my mind, which would not only enable us to investigate the sounds produced by masses, but would also permit us to test the more general proposition that *sonorousness, under the influence of intermittent light, is a property common to all matter.*

The substance to be tested was to be placed in the interior of a transparent vessel, made of some material which (like glass) is transparent to light, but practically opaque to sound.

Under such circumstances the light could get in, but the sound produced by the vibration of the substance could not get out. The audible effects could be studied by placing the ear in communication with the interior of the vessel by means of a hearing-tube.

Some preliminary experiments were made in Paris to test this idea, and the results were so promising that they were communicated to the French Academy on the 11th of October, 1880, in a note read for me by Mr. Antoine Breguet.* Shortly afterwards I wrote to Mr. Tainter, suggesting that he should carry on the investigation in America, as circumstances prevented me from doing so myself in Europe. As these experiments seem to have formed the common starting-point for a series of independent researches of the most important character, carried on simultaneously, in America by Mr. Tainter, and in Europe by M. Mercadier,† Prof. Tyndall,‡ W. E. Röntgen,§ and W. H. Preece,‖ I may be permitted to quote from my letter to Mr. Tainter the passage describing the experiments referred to:—

"Metropolitan Hotel, Rue Cambon, Paris,
"November 2nd, 1880.

"DEAR MR. TAINTER,—* * * I have devised a method of producing sounds by the action of an intermittent beam of light from substances that cannot be obtained in the shape of thin diaphragms or in the tubular form; indeed, the method is specially adapted to testing the generality of the phenomenon we have discovered, as it can be adapted to solids, liquids, and gases.

"Place the substance to be experimented with in a glass test-tube, connect a rubber tube with the mouth of the test-tube, placing the other end of the pipe to the ear. Then focus the intermittent beam upon the substance in the tube. I have tried a large number of substances in this way with great success, although it is extremely difficult to get a glimpse of the sun here, and when it does shine the intensity of the light is not to be compared with that to be obtained in Washington. I got splendid effects from crystals of bichromate of potash, crystals of sulphate of copper, and from tobacco smoke. A whole cigar placed in the test-tube produced a very loud sound. I could not hear anything from plain water, but when the water was discoloured with ink a feeble sound was heard. I would suggest that you might repeat these experiments and extend the results," &c., &c.

Upon my return to Washington in the early part of January,¶ Mr. Tainter communicated to me the results of the experiments he had made in my laboratory during my absence in Europe.

He had commenced by examining the sonorous properties of a vast number of substances inclosed in test-tubes in a simple empirical search for loud effects. He was thus led gradually to the discovery that cotton-wool, worsted, silk, and fibrous materials generally, produced much louder sounds than hard rigid bodies like crystals, or diaphragms such as we had hitherto used.

In order to study the effects under better circumstances he inclosed his materials in a conical cavity in

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* *Proceedings of American Association for the Advancement of Science*, August 27, 1880; see, also, *American Journal of Science*, vol. xx. p. 305; *Journal of the American Electrical Society*, vol. iii, p. 3; *Journal of the Society of Telegraph Engineers and Electricians*, vol. ix p. 404; *Annales de Chimie et de Physique*, vol. xxi.

* *Comptes Rendus*, vol. xci p. 595.

† "Notes on Radiophony," *Comptes Rendus*, Dec. 6th and 13th, 1880; Feb. 21st and 28th, 1881. See also *Journal de Physique* vol. x. p. 53.

‡ "Action of an Intermittent Beam of Radiant Heat upon Gaseous Matter," *Proc. Royal Society*, Jan. 13th, 1881, vol. xxxi. p. 307.

§ "On the Tones which arise from the Intermittent Illumination of a Gas," see *Annalen der Phys. und Chemie*, Jan. 1881, No. 1, p. 155.

‖ "On the Conversion of Radiant Energy into Sonorous Vibrations," *Proc. Royal Society*, March 10th, 1881, vol. xxxi. p. 506.

¶ On the 7th of January.

a piece of brass closed by a flat plate of glass. A brass tube leading into the cavity served for connection with the hearing-tube. When this conical cavity was stuffed with worsted or other fibrous materials the sounds produced were much louder than when a test-tube was employed. This form of receiver is shown in fig. 1.

Mr. Tainter next collected silks and worsteds of different colours, and speedily found that the darkest shades produced the best effects. Black worsted especially gave an extremely loud sound.

As white cotton-wool had proved itself equal, if not superior, to any other white fibrous material before tried, he was anxious to obtain coloured specimens for comparison. Not having any at hand, however, he tried the effect of darkening some cotton-wool with lamp-black. Such a marked reinforcement of the sound resulted that he was induced to try lamp-black alone.

About a teaspoonful of lamp-black was placed in a test-tube and exposed to an intermittent beam of sunlight. The sound produced was much louder than any heard before.

Upon smoking a piece of plate-glass, and holding it in the intermittent beam with the lamp-black surface towards the sun, the sound produced was loud enough to be heard, with attention, in any part of the room. With the lamp-black surface turned from the sun the sound was much feebler.

Mr. Tainter repeated these experiments for me immediately upon my return to Washington, so that I might verify his results.

Upon smoking the interior of the conical cavity shown in fig. 1, and then exposing it to the intermittent beam, with the glass lid in position as shown, the effect was perfectly startling. The sound was so loud as to be actually painful to an ear placed closely against the end of the hearing-tube.

The sounds, however, were sensibly louder when we placed some smoked wire gauze in the receiver, as illustrated in the drawing, fig. 1.

When the beam was thrown into a resonator, the interior of which had been smoked over a lamp, most curious alternations of sound and silence were observed. The interrupting disc was set rotating at a high rate of speed, and was then allowed to come gradually to rest. An extremely feeble musical tone was at first heard, which gradually fell in pitch as the rate of interruption grew less. The loudness of the sound produced varied in the most interesting manner. Minor reinforcements were constantly occurring, which became more and more marked as the true pitch of the resonator was neared. When at last the frequency of interruption corresponded to the frequency of the fundamental of the resonator, the sound produced was so loud that it might have been heard by an audience of hundreds of people.

The effects produced by lamp-black seemed to me to be very extraordinary, especially as I had a distinct recollection of experiments made in the summer of 1880 with smoked diaphragms, in which no such reinforcement was noticed.

Upon examining the records of our past photophonic experiments we found in vol. vii., p. 57, the following note:—

"Experiment V.—Mica diaphragm covered with lamp-black on side exposed to light.

"Result: distinct sound, about same as without lamp-black.—A. G. B., July 18th, 1880.

"Verified the above, but think it somewhat louder than when used without lamp-black.—S. T., July 18th, 1880."

Upon repeating this old experiment we arrived at the same result as that noted. Little if any augmentation of sound resulted from smoking the mica. In this experiment the effect was observed by placing the mica diaphragm against the ear and also by listening through a hearing-tube one end of which was closed by the diaphragm. The sound was found to be more audible through the free air when the ear was placed as near to the lamp-black surface as it could be brought without shading it.

At the time of my communication to the American Association I had been unable to satisfy myself that the substances which had become sonorous under the direct influence of intermittent sunlight were capable of reproducing the sounds of articulate speech under the action of an undulatory beam from our photophonic transmitter. The difficulty in ascertaining this will be understood by considering that the sounds emitted by thin diaphragms and tubes were so feeble that it was impracticable to produce audible effects from substances in these conditions at any considerable distance away from the transmitter; but it was equally impossible to judge of the effects produced by our articulate transmitter at a short distance away because the speaker's voice was directly audible through the air. The extremely loud sounds produced from lamp-black have enabled us to demonstrate the feasibility of using this

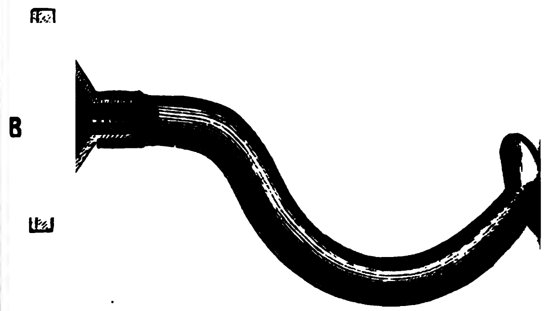


FIG. 1.

substance in an articulating photophone in place of the electrical receiver formerly employed.

The drawing, fig. 2, illustrates the mode in which the experiment was conducted. The diaphragm of the transmitter, A, was only 5 centimetres in diameter, the diameter of the receiver, B, was also 5 centimetres, and the distance between the two was 40 metres, or 800 times the diameter of the transmitting diaphragm. We were unable to experiment at greater distances without a heliostat on account of the difficulty of keeping the light steadily directed on the receiver. Words and sentences spoken into the transmitter in a low tone of voice were audibly reproduced by the lamp-black receiver.

In fig. 3 is shown a mode of interrupting a beam of sunlight for producing distant effects without the use of lenses. Two similarly-perforated discs are employed, one of which is set in rapid rotation, while the other remains stationary. This form of interrupter is also admirably adapted for work with artificial light. The receiver illustrated in the drawing consists of a parabolic reflector, in the focus of which is placed a glass vessel, A, containing lamp-black or other sensitive substance, and connected with a hearing-tube. The beam of light is interrupted by its passage through the two slotted discs shown at B, and in operating the instrument musical signals like the dots and dashes of the Morse alphabet are produced from the sensitive

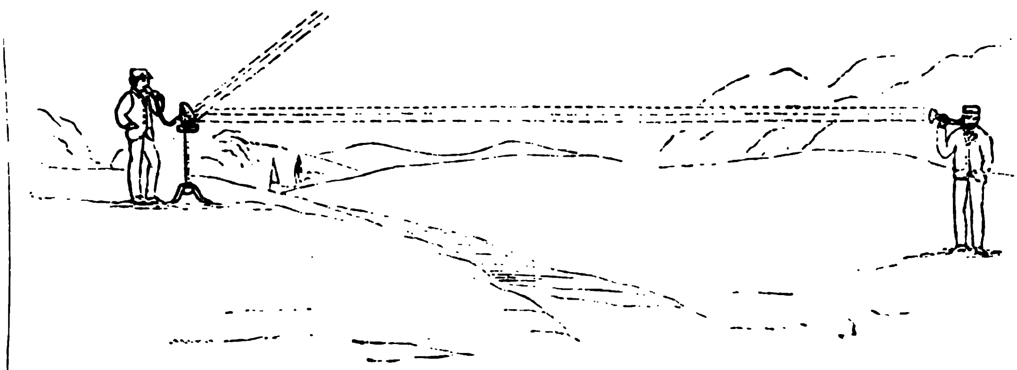
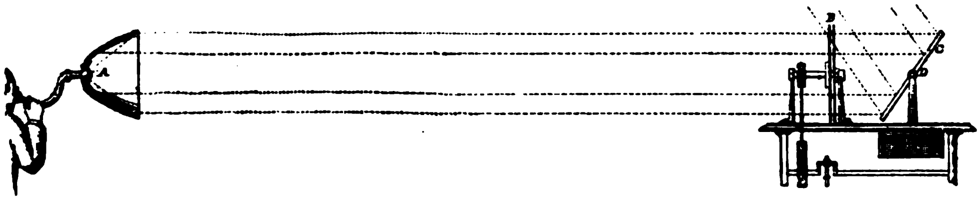


Fig. 2.

Fig. 3.



receiver, A, by slight motions of the mirror, C, about its axis, D.

In place of the parabolic reflector shown in the figure, a conical reflector like that recommended by Prof. Sylvanus Thompson* can be used, in which case a cylindrical glass vessel would be preferable to the flask, A, shown in the figure.

In regard to the sensitive materials that can be employed, our experiments indicate that in the case of solids the physical condition and the colour are two conditions that markedly influence the intensity of the sonorous effects. *The loudest sounds are produced from substances in a loose, porous, spongy condition, and from those that have the darkest or most absorbent colours.*

The materials from which the best effects have been produced are cotton-wool, worsted, fibrous materials generally, cork, sponge, platinum and other metals in a spongy condition, and lamp-black.

The loud sounds produced from such substances may perhaps be explained in the following manner:—Let us consider, for example, the case of lamp-black—a substance which becomes heated by exposure to rays of all refrangibility. I look upon a mass of this substance as a sort of sponge, with its pores filled with air instead of water. When a beam of sunlight falls upon this mass, the particles of lamp-black are heated, and consequently expand, causing a contraction of the air-spaces or pores among them.

Under these circumstances a pulse of air should be expelled, just as we would squeeze out water from a sponge.

The force with which the air is expelled must be greatly increased by the expansion of the air itself, due to contact with the heated particles of lamp-black. When the light is cut off the converse process takes place. The lamp-black particles cool and contract, thus enlarging the air-spaces among them, and the inclosed air also becomes cool. Under these circumstances a partial vacuum should be formed among the particles, and the outside air would then be absorbed, as water is by a sponge when the pressure of the hand is removed.

I imagine that in some such manner as this a wave of condensation is started in the atmosphere each time a beam of sunlight falls upon lamp-black, and a wave of rarefaction is originated when the light is cut off. *We can thus understand how it is that a substance like lamp-black produces intense sonorous vibrations in the surrounding air, while at the same time it communicates a very feeble vibration to the diaphragm or solid bed upon which it rests.*

This curious fact was independently observed in England by Mr. Preece, and it led him to question whether, in our experiments with thin diaphragms, the sound heard was due to the vibration of the disc or (as Prof. Hughes had suggested) to the expansion and contraction of the air in contact with the disc confined in the cavity behind the diaphragm. In his paper read before the Royal Society on the 10th of March, Mr. Preece describes experiments from which he claims to have proved that the effects are wholly due to the vibrations of the confined air, and that the *discs do not vibrate at all.*

I shall briefly state my reasons for disagreeing with him in this conclusion:—

1. When an intermittent beam of sunlight is focussed upon a sheet of hard rubber or other material, a musical tone can be heard, not only by placing the ear immediately behind the part receiving the beam, but by placing it against any portion of the sheet, even though this may be a foot or more from the place acted upon by the light.

2. When the beam is thrown upon the diaphragm of a "Blake Transmitter," a loud musical tone is produced by a telephone connected in the same galvanic circuit with the carbon button, A, fig. 4. Good effects are also produced when the carbon button, A, forms, with the battery, B, a portion of the primary circuit of an induction coil, the telephone, C, being placed in the secondary circuit.

In these cases the wooden box and mouth-piece of the transmitter should be removed, so that no air-cavities may be left on either side of the diaphragm.

It is evident, therefore, that in the case of thin discs a real vibration of the diaphragm is caused by the action of the intermittent beam, independently of any expansion and contraction of the air confined in the cavity behind the diaphragm.

Lord Rayleigh has shown mathematically that a to-and-fro vibration, of sufficient amplitude to produce an audible sound, would result from a periodical communication and abstraction of heat, and he says: "We may conclude, I think, that there is at present no reason for discarding the obvious explanation that the sounds in question are due to the bending of the plates under unequal heating." (*Nature*, xxiii., p. 274.) Mr. Preece, however, seeks to prove that the sonorous effects cannot be explained upon this supposition; but his experimental proof is inadequate to support his conclusion. Mr. Preece expected that if Lord Rayleigh's explanation was correct, the expansion and contraction of a thin strip under the influence of an intermittent beam could be caused to open and close a galvanic circuit so as to produce a musical tone from a telephone in the circuit. But this was an inadequate way to test the point at issue, for Lord Rayleigh has shown (*Proc. of Roy. Soc.*, 1877) that an audible sound can be produced by a vibration whose amplitude is *less than a ten-millionth of a centimetre*, and certainly such a vibration as that would not have sufficed to operate a "make-and-break contract" like that used by Mr. Preece. The negative results obtained by him cannot, therefore, be considered conclusive.

The following experiments (devised by Mr. Tainter) have given results decidedly more favourable to the theory of Lord Rayleigh than to that of Mr. Preece:—

1. A strip, A, similar to that used in Mr. Preece's experiment, was attached firmly to the centre of an iron diaphragm, B, as shown in fig. 5, and was then pulled taut at right angles to the plane of the diaphragm. When the intermittent beam was focussed upon the strip, A, a clear musical tone could be heard by applying the ear to the hearing-tube, C.

This seemed to indicate a rapid expansion and contraction of the substance under trial.

But a vibration of the diaphragm, B, would also have resulted if the thin strip, A, had acquired a to-and-fro motion, due either to the direct impact of the beam or to the sudden expansion of the air in contact with the strip.

2. To test whether this had been the case an additional strip, D, was attached by its central point only to the strip under trial, and was then submitted to the action of the beam, as shown in fig. 6.

It was presumed that if the vibration of the diaphragm, B, had been due to a *pushing force* acting on the strip, A, that the addition of the strip, D, would not interfere with the effect. But if, on the other hand, it had been due to the longitudinal expansion and contraction of the strip, A, the sound would cease, or at least be reduced. The beam of light falling upon strip, D, was now interrupted as before by the rapid

* *Phil. Mag.*, April, 1881, vol. xi. p. 286.

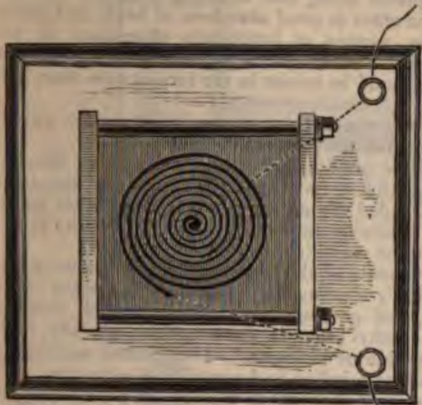


FIG. 7.

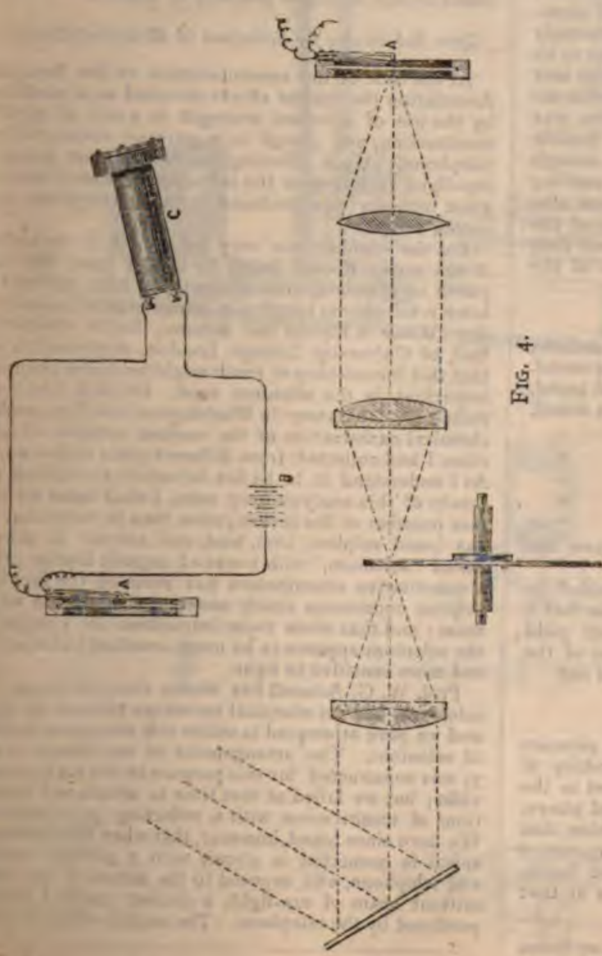


FIG. 4.

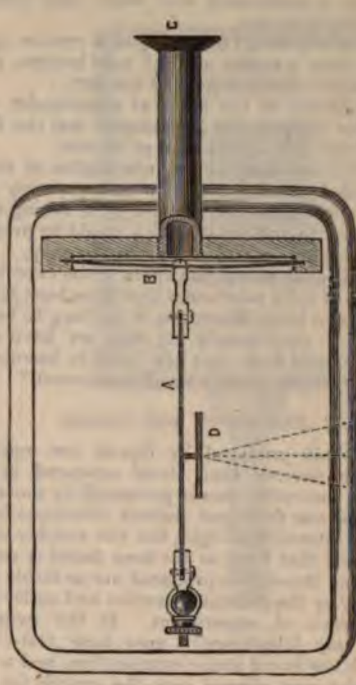


FIG. 6.

FIG. 5.

rotation of a perforated disc, which was allowed to come gradually to rest.

No sound was heard excepting at a certain speed of rotation, when a feeble musical tone became audible.

This result is confirmatory of the first.

The audibility of the effect at a particular rate of interruption suggests the explanation that the strip, D, had a normal rate of vibration of its own.

When the frequency of the interruption of the light corresponded to this, the strip was probably thrown into vibration after the manner of a tuning-fork, in which case a to-and-fro vibration would be propagated down its stem or central support to the strip, A.

This indirectly proves the value of the experiment.

The list of solid substances that have been submitted to experiment in my laboratory is too long to be quoted here, and I shall merely say that we have not yet found one solid body that has failed to become sonorous under proper conditions of experiment.*

Experiments with Liquids.

The sounds produced by liquids are much more difficult to observe than those produced by solids. The high absorptive power possessed by most liquids would lead one to expect intense vibrations from the action of intermittent light, but the number of sonorous liquids that have so far been found is extremely limited, and the sounds produced are so feeble as to be heard only by the greatest attention and under the best circumstances of experiment. In the experiments made in my laboratory a very long test-tube was filled with the liquid under examination, and a flexible rubber-tube was slipped over the mouth far enough down to prevent the possibility of any light reaching the vapour above the surface. Precautions were also taken to prevent reflection from the bottom of the test-tube. An intermittent beam of sun-light was then focussed upon the liquid in the middle portion of the test-tube by means of a lens of large diameter.

Results.

Clear water	No sound audible.
Water discoloured by ink	Feeble sound.
Mercury	No sound heard.
Sulphuric ether*	Feeble, but distinct sound.
Ammonia	" " "
Ammonia-sulphate of copper	" " "
Writing ink	" " "
Indigo in sulphuric acid	" " "
Chloride of copper*	" " "

The liquids distinguished by an asterisk gave the best sounds.

Acoustic vibrations are always much enfeebled in passing from liquids to gases, and it is probable that a form of experiment may be devised which will yield better results by communicating the vibrations of the liquid to the ear through the medium of a solid rod.

Experiments with Gaseous Matter.

On the 29th of November, 1880, I had the pleasure of showing to Prof. Tyndall in the laboratory of the Royal Institution the experiments described in the letter to Mr. Tainter from which I have quoted above, and Prof. Tyndall at once expressed the opinion that the sounds were due to rapid changes of temperature in the body submitted to the action of the beam. Finding that no experiments had been made at that time to test the sonorous properties of different gases, he suggested filling one test-tube with the vapour of sulphuric ether (a good absorbent of heat), and another with the vapour of bisulphide of carbon (a poor absorbent), and he predicted that if any sound was heard it would be louder in the former case than in the latter.

The experiment was immediately made, and the result verified the prediction.

Since the publication of the memoirs of Röntgen* and Tyndall† we have repeated these experiments, and have extended the inquiry to a number of other gaseous bodies, obtaining in every case similar results to those noted in the memoirs referred to.

The vapours of the following substances were found to be highly sonorous in the intermittent beam: Water vapour, coal gas, sulphuric ether, alcohol, ammonia, amylene, ethyl bromide, diethylamene, mercury, iodine, and peroxide of nitrogen. The loudest sounds were obtained from iodine and peroxide of nitrogen.

I have now shown that sounds are produced by the direct action of intermittent sun-light from substances in every physical condition (solid, liquid, and gaseous), and the probability is therefore very greatly increased that sonorousness under such circumstances will be found to be a universal property of matter.

Upon Substitutes for Selenium in Electrical Receivers.

At the time of my communication to the American Association the loudest effects obtained were produced by the use of selenium, arranged in a cell of suitable construction, and placed in a galvanic circuit with a telephone. Upon allowing an intermittent beam of sun-light to fall upon the selenium a musical tone of great intensity was produced from the telephone connected with it.

But the selenium was very inconstant in its action. It was rarely, if ever found to be the case, that two pieces of selenium, even of the same stick, yielded the same results under identical circumstances of annealing, &c. While in Europe last autumn, Doctor Chichester Bell, of University College, London, suggested to me that this inconstancy of result might be due to chemical impurities in the selenium used. Dr. Bell has since visited my laboratory in Washington, and has made a chemical examination of the various samples of selenium I had collected from different parts of the world. As I understand it to be his intention to publish the results of this analysis very soon, I shall make no further mention of his investigation than to state that he has found sulphur, iron, lead, and arsenic in the so-called "selenium," with traces of organic matter; that a quantitative examination has revealed the fact that sulphur constitutes nearly one per cent. of the whole mass; and that when these impurities are eliminated the selenium appears to be more constant in its action and more sensitive to light.

Prof. W. G. Adams‡ has shown that tellurium, like selenium, has its electrical resistance affected by light, and we have attempted to utilise this substance in place of selenium. The arrangement of cell (shown in fig. 7) was constructed for this purpose in the early part of 1880; but we failed at that time to obtain any indications of sensitiveness with a reflecting galvanometer. We have since found, however, that when this tellurium spiral is connected in circuit with a galvanic battery and telephone, and exposed to the action of an intermittent beam of sun-light, a distinct musical tone is produced by the telephone. The audible effect is much

* Carbon and thin microscope glass are mentioned in my Boston paper as non-responsive, and powdered chlorate of potash in the communication to the French Academy (*Comptes Rendus*, vol. xci. p. 595). *All these substances have since yielded sounds under more careful conditions of experiment.*

* *Ann. der Phys. und Chem.*, 1881, No. 1, p. 155.
† *Proc. Roy. Soc.*, vol. xxxi. p. 307.
‡ *Proc. Roy. Soc.*, vol. xxiv. p. 163.

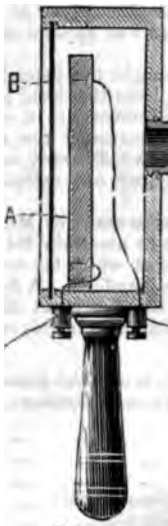


FIG. 9.

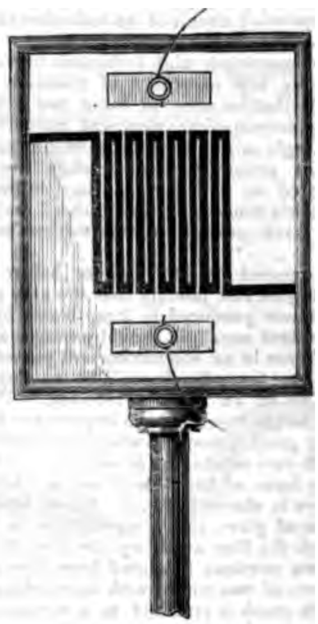


FIG. 8.

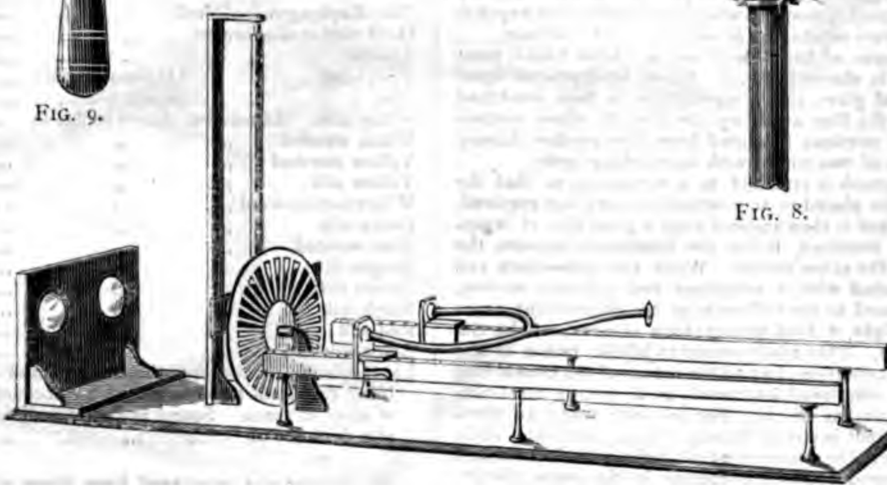


FIG. 10.

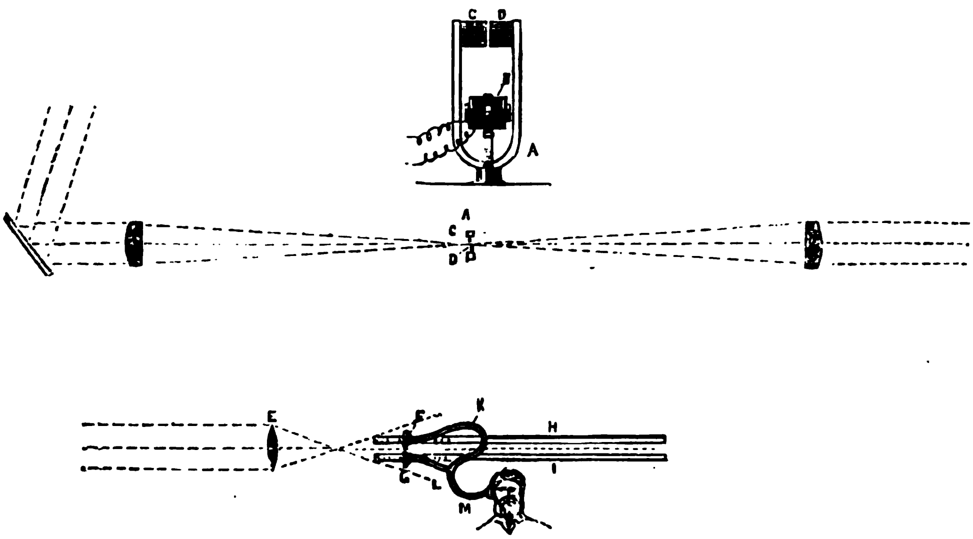


FIG. 11.

increased by placing the tellurium cell with the battery in the primary circuit of an induction coil, and placing the telephone in the secondary circuit.

The enormously high resistance of selenium and the extremely low resistance of tellurium suggested the thought that an alloy of these two substances might possess intermediate electrical properties. We have accordingly mixed together selenium and tellurium in different proportions, and while we do not feel warranted at the present time in making definite statements concerning the results, I may say that such alloys have proved to be sensitive to the action of light.

It occurred to Mr. Tainter before my return to Washington last January that the very great molecular disturbance produced in lamp-black by the action of intermittent sun-light should produce a corresponding disturbance in an electric current passed through it, in which case lamp-black could be employed in place of selenium in an electric receiver. This has turned out to be the case, and the importance of the discovery is very great, especially when we consider the expense of such rare substances as selenium and tellurium.

The form of lamp-black cell we have found most effective is shown in fig. 8. Silver is deposited upon a plate of glass, and a zigzag line is then scratched through the film, as shown, dividing the silver surface into two portions insulated from one another, having the form of two combs with interlocking teeth.

Each comb is attached to a screw-cup, so that the cell can be placed in an electrical circuit when required. The surface is then smoked until a good film of lamp-black is obtained, filling the interstices between the teeth of the silver combs. When the lamp-black cell is connected with a telephone and galvanic battery, and exposed to the influence of an intermittent beam of sun-light, a loud musical tone is produced by the telephone. This result seems to be due rather to the physical condition than to the nature of the conducting material employed, as metals in a spongy condition produce similar effects. For instance, when an electrical current is passed through spongy platinum while it is exposed to intermittent sun-light, a distinct musical tone is produced by a telephone in the same circuit. In all such cases the effect is increased by the use of an induction coil; and the sensitive cells can be employed for the reproduction of articulate speech as well as for the production of musical sounds.

We have also found that loud sounds are produced from lamp-black by passing through it an intermittent electrical current; and that it can be used as a telephonic receiver for the reproduction of articulate speech by electrical means.

A convenient mode of arranging a lamp-black cell for experimental purposes is shown in fig. 9. When an intermittent current is passed through the lamp-black, A, or when an intermittent beam of sunlight falls upon it through the glass plate, B, a loud musical tone can be heard by applying the ear to the hearing-tube, C. When the light and the electrical current act simultaneously, two musical tones are perceived, which produce beats when nearly of the same pitch. By proper arrangements a complete interference of sound can undoubtedly be produced.

Upon the Measurement of the Sonorous Effects Produced by Different Substances.

We have observed that different substances produce sounds of very different intensities under similar circumstances of experiment, and it has appeared to us that very valuable information might be obtained if we could measure the audible effects produced. For this purpose we have constructed several different forms of apparatus for studying the effects, but as our researches are not yet complete I shall confine myself to a simple description of some of the forms of apparatus we have devised.

When a beam of light is brought to a focus by means of a lens, the beam diverging from the focal point becomes weaker as the distance increases in a calculable degree. Hence, if we can determine the distances from the focal point at which two different substances emit sounds of equal intensity, we can calculate their relative sonorous powers.

Preliminary experiments were made by Mr. Tainter during my absence in Europe to ascertain the distance from the focal point of a lens at which the sound produced by a substance became inaudible. A few of the results obtained will show the enormous differences existing between different substances in this respect.

Distance from Focal Point of Lens at which Sounds become Inaudible with Different Substances.

Zinc diaphragm (polished)	... ...	1·51 m.
Hard rubber diaphragm	... ...	1·90 ,,
Tin-foil ,,	... ...	2·00 ,,
Telephone ,,	(Japanned iron) ...	2·15 ,,
Zinc ,,	(unpolished)... ...	2·15 ,,
White silk.	(In receiver shown in fig. 1) ...	3·10 ,,
White worsted ,,	,, ...	4·01 ,,
Yellow worsted ,,	,, ...	4·06 ,,
Yellow silk ,,	,, ...	4·13 ,,
White cotton-wool ,,	,, ...	4·38 ,,
Green silk ,,	,, ...	4·52 ,,
Blue worsted ,,	,, ...	4·69 ,,
Purple silk ,,	,, ...	4·82 ,,
Brown silk ,,	,, ...	5·02 ,,
Black silk ,,	,, ...	5·21 ,,
Red silk ,,	,, ...	5·24 ,,
Black worsted ,,	,, ...	6·50 ,,
Lamp-black. In receiver the limit of audibility could not be determined on account of want of space. Sound perfectly audible at a distance of	... ...	10·00 ,,

Mr. Tainter was convinced from these experiments that this field of research promised valuable results, and he at once devised an apparatus for studying the effects, which he described to me upon my return from Europe. The apparatus has since been constructed, and I take great pleasure in showing it to you to-day.

(1.) A beam of light is received by two similar lenses, fig. 10, which bring the light to a focus on either side of the interrupting disc. The two substances whose sonorous powers are to be compared are placed in the receiving vessels (so arranged as to expose equal surfaces to the action of the beam), which communicate by flexible tubes, of equal length, with the common hearing-tube. The receivers are placed upon slides, which can be moved along the graduated supports. The beams of light passing through the interrupting disc are alternately cut off by the swinging of a pendulum. Thus a musical tone is produced. One of the receivers is kept at a constant point upon its scale, and the other receiver is moved towards or from the focus of its beam until the ear decides that the sounds produced are of equal intensity. The relative positions of the receivers are then noted.

(2.) Another method of investigation is based upon the production of an interference of sound, and the apparatus employed is shown in fig. 11. The interrupter consists of a tuning-fork, A, which is kept in continuous vibration by means of an electro-magnet, B.

A powerful beam of light is brought to a focus

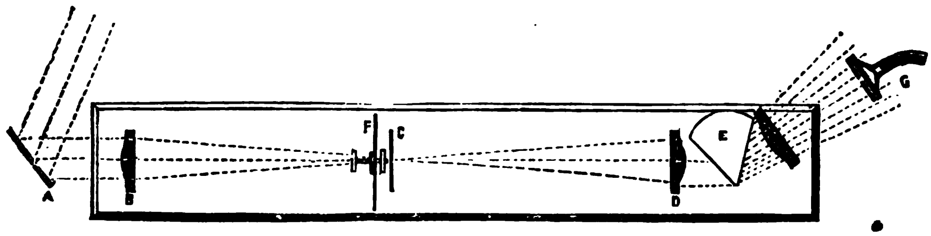


FIG 12.

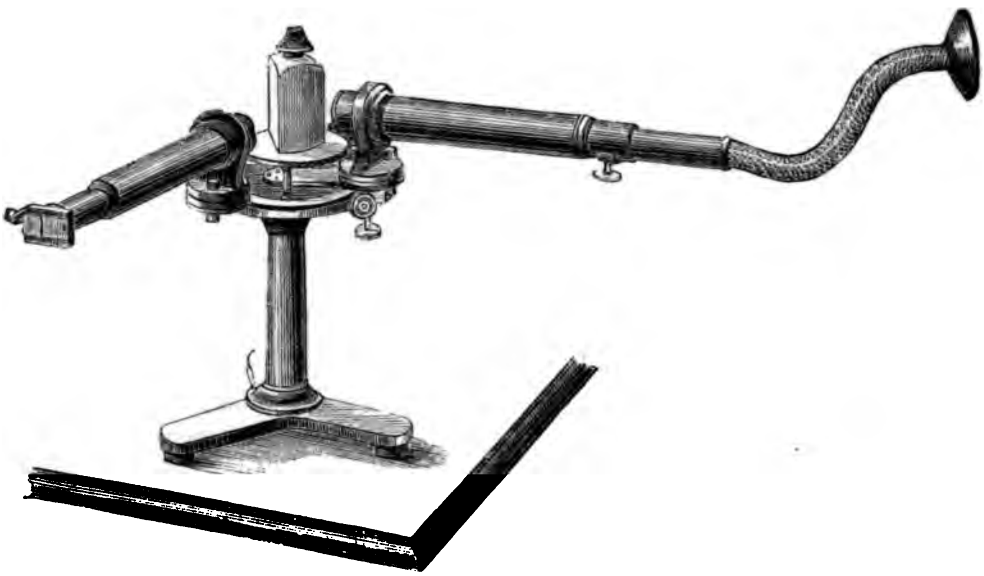


FIG. 13.

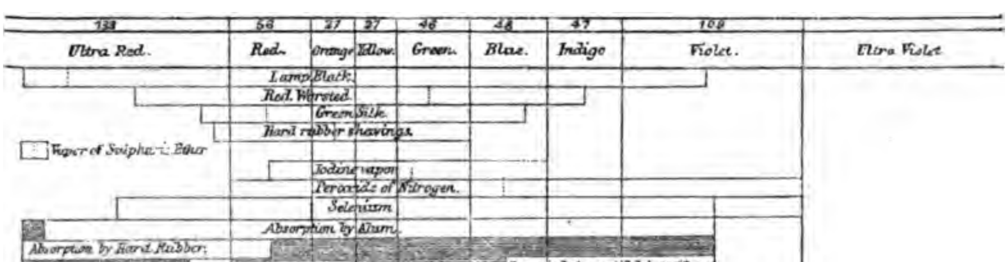


FIG. 14.

between the prongs of the tuning-fork, A, and the passage of the beam is more or less obstructed by the vibration of the opaque screens, C, D, carried by the prongs of the fork.

As the tuning-fork, A, produces a sound by its own vibration, it is placed at a sufficient distance away to be inaudible through the air, and a system of lenses is employed for the purpose of bringing the undulating beam of light to the receiving lens, E, with as little loss as possible. The two receivers, F, G, are attached to slides, H, I, which move upon opposite sides of the axis of the beam, and the receivers are connected by flexible tubes of unequal length, K, L, communicating with the common hearing-tube, M.

The length of the tube, K, is such that the sonorous vibrations from the receivers, F, G, reach the common hearing-tube, M, in opposite phases. Under these circumstances silence is produced when the vibrations in the receivers, F, G, are of equal intensity. When the intensities are unequal, a residual effect is perceived. In operating the instrument the position of the receiver, G, remains constant, and the receiver, F, is moved to or from the focus of the beam until complete silence is produced. The relative positions of the two receivers are then noted.

(3.) Another mode is as follows: The loudness of a musical tone produced by the action of light is compared with the loudness of a tone of similar pitch produced by electrical means. A rheostat introduced into the circuit enables us to measure the amount of resistance required to render the electrical sound equal in intensity to the other.

(4.) If the tuning-fork, A, in fig. 11, is thrown into vibration by an undulatory instead of an intermittent current passed through the electro-magnet, B, it is probable that a musical tone, electrically produced in the receiver, F, by the action of the same current, would be found capable of extinguishing the effect produced in the receiver, G, by the action of the undulatory beam of light, in which case it should be possible to establish an acoustic balance between the effects produced by light and electricity by introducing sufficient resistance into the electric circuit.

Upon the Nature of the Rays that produce Sonorous Effects in Different Substances.

In my paper read before the American Association last August, and in the present paper, I have used the word "light" in its usual rather than its scientific sense, and I have not hitherto attempted to discriminate the effects produced by the different constituents of ordinary light—the thermal, luminous, and actinic rays. I find, however, that the adoption of the word "photophone" by Mr. Tainter and myself has led to the assumption that we believed the audible effects discovered by us to be due entirely to the action of luminous rays. The meaning we have uniformly attached to the words "photophone" and "light" will be obvious from the following passage, quoted from my Boston paper:—

"Although effects are produced as above shown by forms of radiant energy, which are invisible, we have named the apparatus for the production and reproduction of sound in this way the 'photophone' *because an ordinary beam of light contains the rays which are operative.*"

To avoid in future any misunderstandings upon this point we have decided to adopt the term "*radiophone,*" proposed by M. Mercadier, as a general term signifying an apparatus for the production of sound by any form of radiant energy, limiting the words *thermophone*, *photophone*, and *actinophone*, to apparatus for the production of sound by thermal, luminous, or actinic rays respectively.

M. Mercadier, in the course of his researches in radiophony, passed an intermittent beam from an electric lamp through a prism, and then examined the audible effects produced in different parts of the spectrum. (*Comptes Rendus*, Dec. 6, 1880.)

We have repeated this experiment, using the sun as our source of radiation, and have obtained results somewhat different from those noted by M. Mercadier.

A beam of sunlight was reflected from a heliostat, A, fig. 12, through an achromatic lens, B, so as to form an image of the sun upon the slit, C.

The beam then passed through another achromatic lens, D, and through a bisulphide of carbon prism, E, forming a spectrum of great intensity, which, when focussed upon a screen, was found to be sufficiently pure to show the principal absorption lines of the solar spectrum.

The disc-interrupter, F, was then turned with sufficient rapidity to produce from five to six hundred interruptions of the light per second, and the spectrum was explored with the receiver, G, which was so arranged that the lamp-black surface exposed was limited by a slit as shown.

Under these circumstances sounds were obtained in every part of the visible spectrum, excepting the extreme half of the violet, as well as in the ultra-red. A continuous increase in the loudness of the sound was observed upon moving the receiver, G, gradually from the violet into the ultra-red. The point of maximum sound lay very far out in the ultra-red. Beyond this point the sound began to decrease, and then stopped so suddenly that a very slight motion of the receiver, G, made all the difference between almost maximum sound and complete silence.

(2.) The lamp-blacked wire gauze was then removed and the interior of the receiver, G, was filled with red worsted. Upon exploring the spectrum as before entirely different results were obtained. The maximum effect was produced in the green at that part where the red worsted appeared to be black. On either side of this point the sound gradually died away, becoming inaudible on the one side in the middle of the indigo, and on the other at a short distance outside the edge of the red.

(3.) Upon substituting green silk for red worsted the limits of audition appeared to be the middle of the blue and a point a short distance out in the ultra-red. Maximum in the red.

(4.) Some hard-rubber shavings were now placed in the receiver, G. The limits of audibility appeared to be on the one hand the junction of the green and blue, and on the other the outside edge of the red. Maximum in the yellow. Mr. Tainter thought he could hear a little way into the ultra-red, and to his ear the maximum was about the junction of the red and orange.

(5.) A test-tube containing the vapour of sulphuric ether was then substituted for the receiver, G. Commencing at the violet end, the test-tube was gradually moved down the spectrum and out into the ultra-red without audible effect, but when a certain point far out in the ultra-red was reached a distinct musical tone suddenly made its appearance, which disappeared as suddenly on moving the test-tube a very little further on.

(6.) Upon exploring the spectrum with a test-tube containing the vapour of iodine the limits of audibility appeared to be the middle of the red and the junction of the blue and indigo. Maximum in the green.

(7.) A test-tube containing peroxide of nitrogen was substituted for that containing iodine. Distinct sounds

ained in all parts of the visible spectrum, but s were observed in the ultra-red.
aximum effect seemed to me to be in the blue. ds were well marked in all parts of the violet, n fancied that the audible effect extended a ' into the ultra-violet, but of this I cannot be Upon examining the absorption spectrum of of nitrogen it was at once observed that the ı sound was produced in that part of the where the greatest number of absorption le their appearance.
e spectrum was now explored by a selenium the audible effects were observed by means of ne in the same galvanic circuit with the cell. imum effect was produced in the red. The ffect extended a little way into the ultra-red e hand and up as high as the middle of the the other.
gh the experiments so far made can only be d as preliminary to others of a more refined think we are warranted in concluding that *e of the rays that produce sonorous effects in substances depends upon the nature of the sub- at are exposed to the beam, and that the sounds ry case due to those rays of the spectrum that ed by the body.*

The Spectrophone.

periments upon the range of audibility of substances in the spectrum have led us to the on of a new instrument for use in spectrum which was described and exhibited to the ical Society of Washington last Saturday.* piece of a spectroscope is removed, and sensi- tances are placed in the focal point of the it behind an opaque diaphragm containing a se substances are put in communication with y means of a hearing-tube, and thus the in- is converted into a veritable "spectrophone," shown in fig. 13.
e we smoke the interior of our spectrophonic and fill the cavity with peroxide of nitrogen have then a combination that gives us good n all parts of the spectrum (visible and except the ultra-violet. Now, pass a rapidly- d beam of light through some substance sorption spectrum is to be investigated, and sound and silence are observed upon exploring rum, the silent positions corresponding to the n bands. Of course, the ear cannot for one compete with the eye in the examination of e part of the spectrum; but in the invisible nd the red, where the eye is useless, the ear is e. In working in this region of the spectrum k alone may be used in the spectrophonic Indeed, the sounds produced by this sub- the ultra-red are so well marked as to con- r instrument a most reliable and convenient for the thermo-pile. A few experiments that made may be interesting.
e interrupted beam was filtered through a solution of alum.
: The range of audibility in the ultra-red was educed by the absorption of a narrow band of of lowest refrangibility. The sounds in the rt of the spectrum seemed to be unaffected.
hin sheet of hard rubber was interposed in of the beam.
: Well-marked sounds in every part of the No sounds in the visible part of the excepting the extreme half of the red.

These experiments reveal the cause of the curious fact alluded to in my paper read before the American Association last August—that sounds were heard from selenium when the beam was filtered through both hard rubber and alum at the same time. (See table of results in fig. 14.)

(3.) A solution of ammonia-sulphate of copper was tried.

Result: When placed in the path of the beam the spectrum disappeared, with the exception of the blue and violet end. To the eye the spectrum was thus reduced to a single broad band of blue-violet light. To the ear, however, the spectrum revealed itself as two bands of sound with a broad space of silence between. The invisible rays transmitted constituted a narrow band just outside the red.

I think I have said enough to convince you of the value of this new method of examination, but I do not wish you to understand that we look upon our results as by any means complete. It is often more interesting to observe the first totterings of a child than to watch the firm tread of a full-grown man, and I feel that *our* first footsteps in this new field of science may have more of interest to you than the fuller results of mature research. This must be my excuse for having dwelt so long upon the details of incomplete experiments.

I recognise the fact that the spectrophone must ever remain a mere adjunct to the spectroscope, but I anticipate that it has a wide and independent field of usefulness in the investigation of absorption spectra in the ultra-red.

* *roc. of Phil. Soc. of Washington*, April 16, 1881.

TELEGRAPHIC APPARATUS IN USE IN THE BRITISH POSTAL TELEGRAPH DEPARTMENT.

XXXIII.

Telephones.

Since the adoption of the Gower-Bell telephone by the Postal authorities a large number have been brought into use. As the conditions under which they have to work differ to a considerable extent, two patterns have been adopted, viz., one with a bell fitted in the instrument itself, and worked by the direct line current; the other pattern is fitted with a soft iron relay, which works a local bell.

The general construction of the instrument is similar to that shown in the number of the Journal for February 1st, page 54; the microphone is formed with eight radiating carbon rods.

Fig. 134 shows the internal connections of the instrument provided with a bell worked by the direct line current.

When the ear tubes are placed in the switches, s_1, s_2, the latter are depressed. A current received from the distant station in this case passes to terminal L, thence through the lever of the button key, K, to the back stop, 2; from the latter it passes through the metal lever, s_1, to the stop, *a*, and from thence through the bell, R, to the brass junction piece, *h*, and from thence direct to earth.

If the key, K, is depressed, then the copper pole of the right-hand half of the battery being connected to contact point, 1, passes from thence through the lever of K to terminal L, and out to line; the zinc of the left-hand half of the battery being to earth the circuit is thus complete, and the current from the

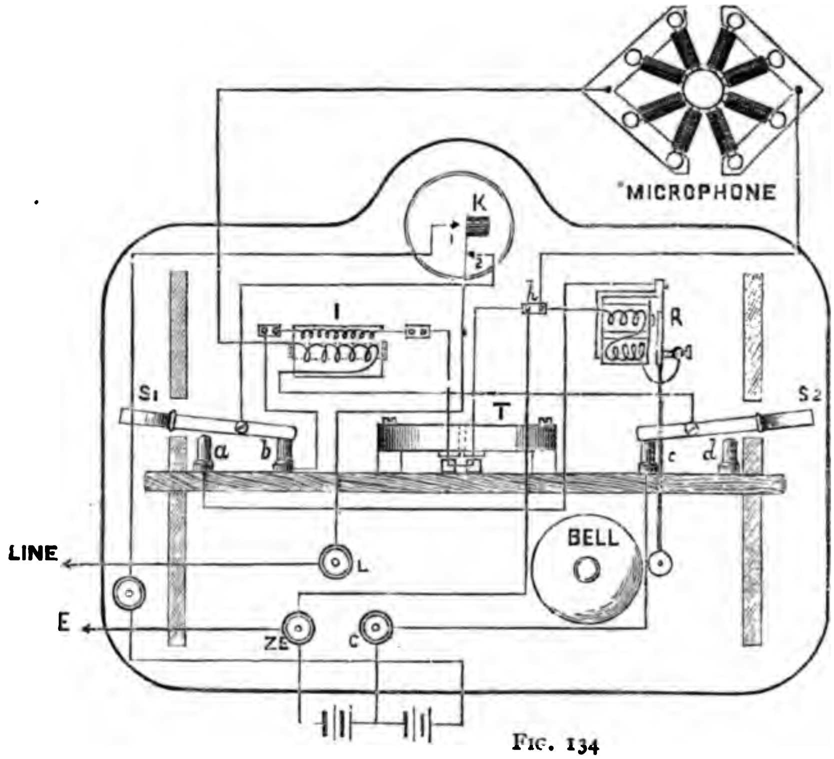


FIG. 134

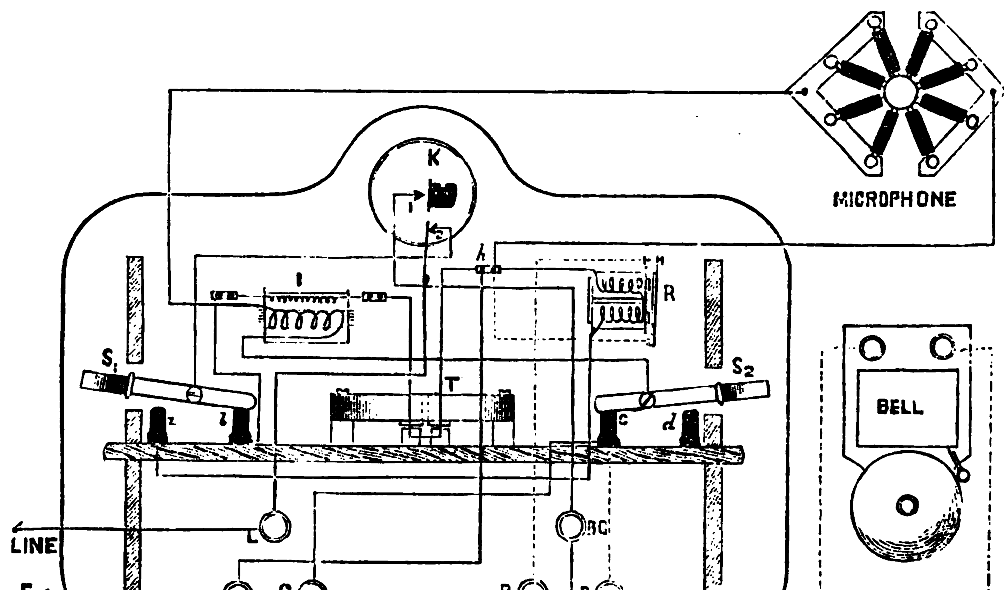


FIG. 135.

battery passes out to line and rings the bell distant station.

n the ear tubes are taken off the switches, then the latter come to the position indicated figure. In this case the zinc of the left-hand the battery becomes connected through Z, E, microphone, the primary wire of the induc-il I, to the switch, S_2, thence to the back ;, c, of the latter, and on to terminal C, and ddle of the battery; thus the circuit of the

tongue of the relay is attracted, the local circuit of the bell is completed with the left-hand portion of the battery by means of the dotted connection shown.

The left-hand half of the battery, which is employed for ringing the local bell and for working with the microphone, need not consist of more than two Leclanché cells for any length of line. The number of cells for the right-hand half of the battery will vary according to the length of the line.

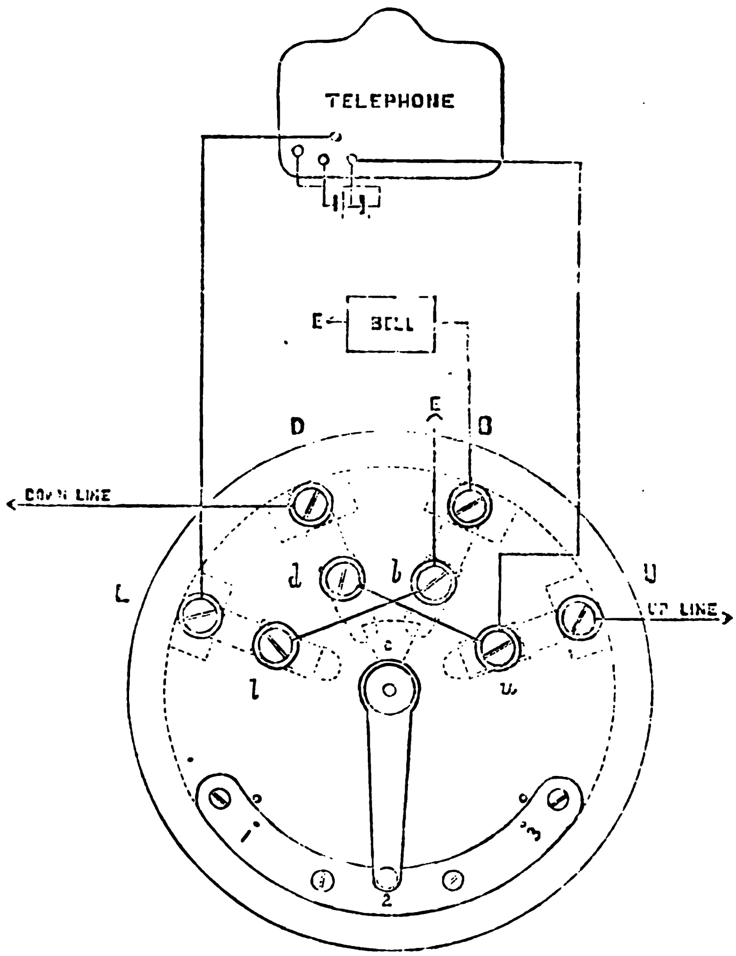


FIG. 136.

id half of the battery is closed through the hone and the primary wire of the induction The secondary wire of the latter has one end ted through the back contact, b, of the switch, a contact, 2, of the key, K, and thence by the of the latter to terminal L and line; the nd of the induction coil is connected to one the telephone receiver, T, whose other end nected to h, and thence to earth.

arrangement of the circuits in fig. 135 are al with those in fig. 134, except that the akes the place of the bell; and when the

The batteries used are the large-sized agglomerate Leclanché, and are found to work well. Care must be taken, however, not to leave the left-hand half on short circuit for any great length of time by leaving the switch, S_2, permanently up.

In cases where a telephone is placed at an intermediate station, it is sometimes required to be able to cut one or other of the terminal stations off when speaking to the other station, the bell being left in circuit with that station which is cut out, so that should that station make a call the latter may be heard. This arrangement is effected by means

of the switch shown by fig. 136. This switch is provided with four pairs of terminal screws, the two terminals in a pair being normally in connection with one another by means of springs. A cam piece, *c*, fixed to the switch handle, rides over these springs, and presses them away from their contacts, and at the same time connects a pair of these springs together; thus, in the figure, the cam has ridden over and pressed away the springs fixed to D and B, from the contacts of terminals *d* and *b*, and has at the same time connected these two springs—that is, terminals D and B, together; whilst the springs being pressed away from contact with the two inner terminals, *d* and *b*, the latter are disconnected.

With the switch in the position shown, the "Down" line is connected through the medium of terminal D, and the spring attached to it, to the cam, *c*, and thence through the medium of the spring attached to terminal B, with the "Bell" and earth. The "Up" line is connected through terminal U, and the spring attached to it, with terminal *u*, and the right-hand wire connected to the telephone, and thence through the latter with terminal L, and the spring connected to it, to earth.

If the switch be moved to "1," then the "Up" line becomes connected through the medium of the cam, *c*, with the bell, to earth; whilst the "Down" line passes on to terminal *d*, thence to terminal *u*, and through the telephone to earth.

Lastly, if the switch be moved to "3," then the "Up" line is connected through the telephone to the "Down" line.

The telephone, of course, has its own bell in addition to the local bell, which is subsidiary, as it were, and only required when through communication is cut off.

Notes.

A DETERMINATION of the electric phenomena which occur on contact of metals and gases has been attempted by Herr Schulze-Berge in Berlin (*Wied. Ann.* No. 2). He worked with a condenser having two circular plates of a given metal, the upper plate being connected with an electrometer and submitted to contact with various gases or to vacuum; the lower connected to earth. The quantity of electricity from a known source requiring to be communicated to the upper plate to make its potential equal to the lower, was measured. *Inter alia*, ozone was found to make gold, platinum, and brass negative to a plate of the same metal in air. Hydrogen always made platinum strongly positive, while its influence on gold was hardly perceptible, and on brass qualitatively various. Chlorine made platinum negative; ammoniacal gas (from aqueous solution) made brass positive. The amount of difference of potential with as similar a treatment as possible of a given pair of plates was very different in the several observations of a series. Nor could a certain relation be discovered between it and the time of action of the gas. It was greatest with two platinum plates, one in hydrogen (viz., 0·214 D). It gradually decreased to a point generally somewhat short of that at the beginning. As to the cause of this decrease, the author thinks it probable that a gradual neutralisation of the electrical double layer takes place.

A DISTURBING CAUSE IN TELEPHONIC TRANSMISSION.—By M. Gaiffe.—Two rods of equal length having been cut from the same steel, of a quality susceptible of strong polarisation without having been tempered, one of them was magnetised as strongly as possible, and they were then introduced into a telephonic circuit. On striking them both in the same manner it was found that the magnetised rod gave energetic currents, whilst the other was relatively inactive. This fact seems capable of explanation on Ampère's theory. In a vibrating magnet there should be produced currents analogous to the extra currents which arise in a solenoid, when the respective position of the spirals is modified by making it vibrate.—*Comptes Rendus.*

APPLICATION OF THE MICROPHONE FOR THE DISCOVERY OF SUBTERRANEAN WATERCOURSES.—Count Hugo v. Engenberg, being desirous of finding a source of water for his castle at Tratzberg, near Hall, in the Tyrol, made use of microphones, sunk in the ground on the declivity of the hill, and connected separately with a single telephone and a small battery. He intends to conduct the experiment by night, when disturbing sounds and vibrations of the ground are less frequent than by day. The apparatus, near which a stream of water flows, will pass the sound to the telephone, and thus reveal the spring. Stagnant water will, of course, have no effect.—*Oesterr.-Ungar. Post.*

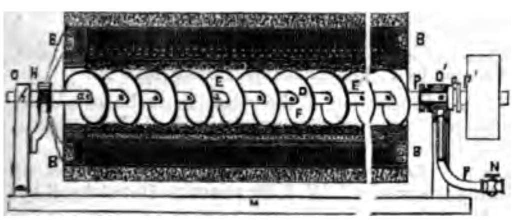
THE National Theatre in Buda-Pest is now illuminated with the electric light. Five lamps of ground glass, arranged to burn for eight hours, are fixed near the ceiling, and are worked by a dynamo-electric machine.—*Pester Lloyd.*

ON THE SECONDARY BATTERY OF M. C. FAURE.—By M. E. Reynier.—The researches of M. Gaston Planté on the polarisation of voltameters have led this learned physicist to the invention of secondary couples with lead plates. These couples accumulate and store up, so to say, the electricity produced by any electro-motor. M. Planté has succeeded in giving his couples a great capacity of storage by means of successive charges and discharges effected methodically. This work of *formation* has the effect of developing on the surface of the lead, and to a certain depth in the thickness of the plates, layers of oxide and of reduced metal in a state of division favourable to the formation of the secondary current. A Planté element of 0·5 square metre of surface, properly formed, can store up a quantity of electro-chemical energy capable of heating to redness for ten minutes 0·08 m. of a platinum wire of 0·001 m. in thickness. By the discharge in tension of a great number of secondary couples, previously charged in quantity, M. Planté has succeeded in obtaining very high electric tensions, which he has further increased by the aid of his rheostatic machine. Some engineers see in this battery the general solution of the question as to the transportation and distribution of electricity, and consequently of energy in all its forms—mechanical force, heat, light, chemical action, &c. But in order to obtain these results it was necessary to give the apparatus a greater capacity of storage, along with a less weight and bulk. This has in fact been effected by M. Faure, whose improvements render the industrial accumulation of electricity possible. The secondary battery of M. Faure is a modification of the Planté battery. The electrodes are of lead, plunged in water acidified with sulphuric acid, but its formation is more thorough and more rapid. In Planté's battery the formation is limited by the thickness of the lead plates. M. Faure gives his couples rapidly an almost boundless power of accumulation by coating the electrodes with

a layer of spongy lead, formed and kept in its place in the following manner:—The two lead plates of the element are each covered with red lead, or another insoluble oxide of lead, and are then surrounded with a felt partition, kept in its place with rivets of lead; these two electrodes are then placed near to each other in a recipient containing acidulated water. If they are very long they are rolled in a spiral. The couple being thus fitted up requires merely to be traversed by an electric current, which brings the red lead to the state of peroxide upon the positive electrode, and to the state of reduced lead on the negative electrode. As soon as the whole mass has been electrolysed the element is formed and charged. On discharging the reduced lead is oxidised, and the peroxidised lead is reduced until the element becomes inert, and is ready to receive a new charge of electricity. Practically a Faure battery of 75 kilos. can thus store up a quantity of electricity capable of doing the work of one horse-power for an hour. Calculations based upon thermo-chemical data show that the weight of the apparatus may be much reduced. The yield of the Faure battery may in certain conditions reach 80 per cent. of the work expended in charging it.—*Comptes Rendus*.

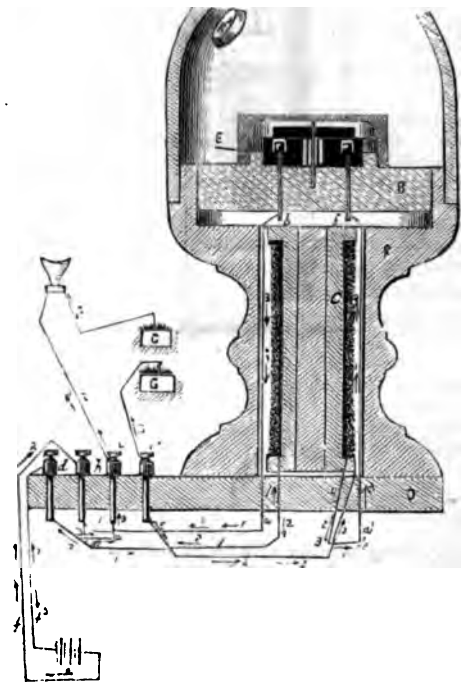
A LARGE meeting of telegraph clerks was held recently at Newcastle-on-Tyne. Severe disappointment was expressed at the continued absence of any notification from the authorities as to whether steps are being taken to remove their grievances. The following resolution was unanimously adopted:—"That, in the opinion of this meeting, there is ground for grave anxiety on the part of the telegraph staff owing to the prolonged delay in the announcement of any scheme of revision for their department, and the absence of any official intimation that the grievances of which they have so long complained are recognised, and that redress is contemplated."

VOELKER'S DYNAMO-ELECTRIC MACHINE.—The armature-cores of this machine, which is shown by the figure, are composed of wires held in slots in a cylindrical carrier, the ends of the wires being bent down upon the wires of the bobbin and the inside of the carrier. Water is conveyed through the hollow shaft and distributed, by means of small holes in the shaft, upon absorbent material, which lines the inner portion of the



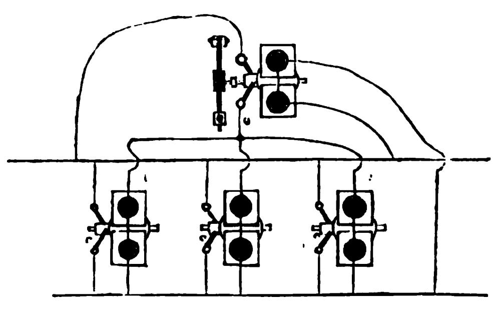
armature. An Archimedean screw within the armature creates a draught of air through the machine in contact with the wet absorbent material. The various parts of the machine are as follows:—The iron wire field magnets, I I, armature bobbin cores, A A, iron cylinder, C, absorbing lining, F, screw, D, hollow shaft, E, commutator, H, brushes, *h h'*, bobbins, K K, bearings, O O', water pipe, P, valve, N, packing boxes, *p p'*, and pulley, S.

LOCKWOOD'S TELEPHONE TRANSMITTER. — This transmitter, shown by the figure, consists of a fixed metal cylinder or base supporting the microphone and inclosing the coil. A dome or mouth-piece, made in the form of a hollow hemisphere, forms a cover for the transmitter; this dome or mouth-piece is made adjustable or susceptible of being rotated on its base or support. A fixed cylindrical metal stand supports the microphone and incloses the coil. The fixed hollow metal stand or base supporting the microphone and inclosing the coil, in combination with a wire or conductor



connecting said fixed base with the ground, substantially as and for the purpose described. The microphone itself consists of a disc of carbon lying on two supporting pieces of the same material.

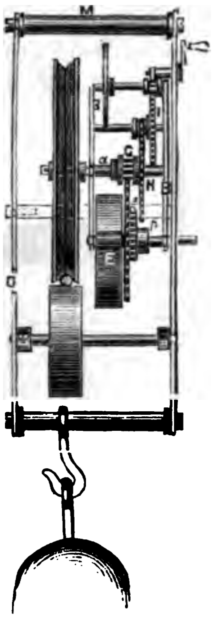
MR. EDISON has recently patented a new method of regulating the generation of electric currents; in this arrangement, which is indicated by the figure, he employs the reverse current from an electric engine to intensify



the field magnets of the generators. The engine is driven by the current from the generators, and its speed varies with the strength of the current.

A NOVEL method of laying telegraph wires has been patented in America by Mr. E. T. Greenfield. This method consists in carrying the ends of the wire from

one point of attachment to another by means of a carrier, driven by a main-spring, which moves auto-



matically along another wire which follows the general direction between the two points. The carrier for the purpose is shown by the figure.

Boston Telegram is the title of a new telegraphic paper published in Boston, America. The subject matter, besides being of the class usual to such publications, is also of a humorous character, with corresponding illustrations well executed.

ONE of the automatic machines which prints the news on tapes of paper at the clubs is said to have delivered a portion of its message on the Opium Bill thus:—"8.30, Mr. Pease still drugging the House." It should have been "addressing."

NICKEL.—The French official returns of the importation of nickel into France during 1879, show that 561,568 kilogrammes of nickel ore came from New Caledonia, where lately large deposits of this metal have been discovered.

A NEW galvanic battery is stated to have been invented by Mr. Coad, which in combination with Mr. Banting Rogers' method of dividing the current, is said to give wonderful results with the electric lamp. A 20 cell battery gave a light of 200 candle-power at intervals of thirty hours for a month without requiring any replenishing. As the new system is shortly to be introduced to the public we shall probably hear something more of it.

MORE than once recently the electric lamps on Blackfriars Bridge, in Bridge Street, at Ludgate Circus, in St. Paul's Churchyard, and along a portion of Cheapside—the lamps supplied on the Brush system—were suddenly extinguished. As there have been very few gas lamps in the streets lighted, the extinction of the electric light placed those thoroughfares in total darkness, to the great inconvenience of passengers and drivers of cabs and omnibuses. The cause of the failure was defective insulation of the wires; the latter are being renewed by ones of stronger make, which will obviate any future failure.

IT is proposed to light the Melbourne Houses of Parliament by the electric light.

New Patents—1881.

1636. "Improvements in apparatus for producing motion by electricity, specially applicable to regulating the electromotive force in systems of applying or distributing energy by electricity for lighting or other purposes." St. G. L. Fox. Dated April 14.

1653. "Electric lamps." J. H. JOHNSON. (Communicated by the Société la Force et la Lumière, Société Génerale d'Electricité.) Dated April 14.

1670. "Electric lamps." G. S. GRIMSTON. Dated April 16.

1676. "Secondary electric or galvanic batteries." J. H. JOHNSON. (Communicated by C. A. Faure.) Dated April 16.

1679. "Improvements in telephonic and telegraphic exchange systems, and in insulating and mounting the conducting wires used for telephonic and telegraphic communication." J. N. CULBERTSON and J. W. BROWN. Dated April 16.

1683. "Electrical apparatus for signalling between railway trains in motion and between trains and stations." A. M. CLARK. (Communicated by A. D'AURIAC.) Dated April 16.

1685. "Electric lamps or regulators." A. M. CLARK. (Communicated by J. M. A. Gerard-Lescuyer.) Dated April 18.

1696. "Telegraphy." S. PITT. (Communicated by O. Lugo.) Dated April 19.

1699. "A new or improved method of block signalling for railways." J. WETTER. (Communicated by R. S. Jennings.) Dated April 19.

1726. "Electrical call or signal apparatus for telegraphic or telephonic purposes." W. R. LAKE. (Communicated by D. H. Rice and J. B. Currier.) Dated April 20. (*Complete.*)

1745. "Electrical batteries." C. D. ABEL. (Communicated by P. Jablochkoff.) Dated April 22.

1762. "Production of the materials to be employed for the purposes of electric insulation." J. A. FLEMING. Dated April 23.

1770. "Receiving and transmitting apparatus of printing telegraphs." W. J. BURNSIDE. Dated April 23.

1783. "Devices for measuring the electric current passing through or used upon a certain circuit." E. G. BREWER. (Communicated by T. A. Edison.) Dated April 25.

1787. "Dynamo-electric machines." A. M. CLARK. (Communicated by H. J. Müller and A. Levett.) Dated April 25.

1789. "Improvements in block signalling on railways and in apparatus connected therewith." J. W. FLETCHER. Dated April 26.

1796. "Railway signalling." H. MORRIS. Dated April 26.

1802. "Improvements in electric lights and fittings and fixtures therefor." P. JENSEN. (Communicated by T. A. Edison.) Dated April 26.

"Telegraphic cables or conductors." W. R. (Communicated by P. B. Delany.) Dated

"Galvanic soles for shoes and boots, chiefly le as socks for same." G. W. Von NAWROCKI. nicated by A. Wienand.) Dated April 27.

"Current governors for dynamo-electric s." H. J. HADDAN. (Communicated by ush.) Dated April 28.

"Improvements in electric lighting and in is therefor." H. J. HADDAN. (Communicated mzée.) Dated April 29.

"Improvements in the construction of rail- d in the adaptation thereto of telegraph wires." .. REDDIE. (Communicated by J. Hunebelle.) pril 29.

"Telegraph cables and other electrical con- ' W. T. HENLEY. Dated April 30.

"Electric telephones." W. MAIN. Dated

"Electro-telegraphic apparatus." J. H. N. Dated May 3.

"Manufacture of carbon conductors for incan- electric lamps." E. G. BREWER. (Communi- T. A. Edison.) Dated May 3.

"Improved construction or arrangement of amp." J. B. ROGERS. Dated May 3.

"Improvements in apparatus for alarm signals ay trains." COMTE (PIERRE AMBJÖRN) DE

"Electric arc lamps." J. BROCKIE. Dated

"System of electric lighting." E. G. BREWER. nicated by T. A. Edison.) Dated May 4.

"Electro-telephonic, or telephonic apparatus." AKE. (Communicated by L. Maiche.) Dated

"An apparatus for controlling the lowest f water-level and the maximum temperature boilers by the medium of electricity." C. (Communicated by R. S. Kopff.) Dated

"Improvements in magneto-electric machines, circuits, and in the method of operating them." Dated May 5. (*Complete.*)

"Electric lighting apparatus." W. R. LAKE. nicated by N. Bouliguine.) Dated May 5.

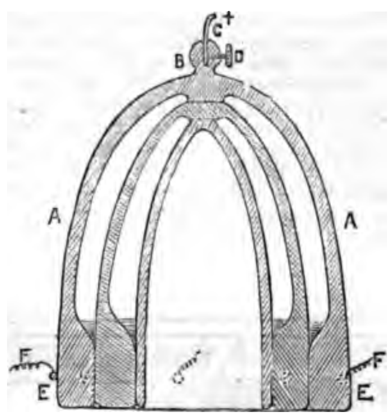
STRACTS OF PUBLISHED SPECIFICATIONS, 1880.

"Railway signalling." ALPHONSE AUGUSTE (A communication from abroad by Joseph , of Paris.) Dated June 17. 8d. The f every train is automatically marked so that f of the neighbouring stations may see the te of the way, calculate the speed of the trains, ase of probable danger give the necessary in- s for slackening the march or stopping. of divers sorts are transmitted by said chief of which are instantaneously perceived by all the all the extent of the way; the machinists can r locomotive and prevent all collision. Other nable the machinists to advise that the orders have been well understood and punctually executed. Finally, on the other hand, it is possible for any train in distress to call for the assistance it may be in need of, which succour can be sent to the very spot where it is, said spot being always very exactly pointed out.

3438. "Securing telegraph wires to their insulators." ARTHUR EDWARD GILBERT. Dated August 25. 2d. Has reference to the gripper described in the number of the TELEGRAPHIC JOURNAL for September 15, 1880. *(Void by reason of the patentee having neglected to file a specification in pursuance of the conditions of the letters patent.)*

3784. "Electric type printing telegraph apparatus." GEORG JONAS DROSTE. Dated September 18. 10d. Has reference to type printing telegraphs in which, by continuous contact closings and interruptions of the line current passing through the electro-magnets of the instruments in connection, the type disc is moved round from letter to letter until the type of the letter to be telegraphed stands opposite the printing appliance which when put into action prints it on a paper band.

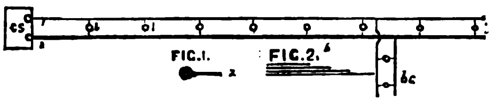
3809. "Dividing and subdividing the electric current for lighting." JOHN BANTING ROGERS. Dated September 20. 6d. The object of this invention is improved means and apparatus for dividing and subdividing the electric current for lighting purposes, by means of conical, semispherical, or bell-shaped apparatus of copper (shown by the figure), to the apex



of which is a clip or other appliance for the attachment of the primary wire from a dynamo or other electric force producer, and with a series of other clips or appliances at the band of the apparatus, to which other wires can be connected for conducting the fluid to any desired number of lamps or carbons. The apex of the apparatus is flat or nearly so, and of greater thickness than the body, that the fluid may be accumulated and governed in and by the apparatus.

3880. "Systems of conductors for the distribution of electricity, &c." PETER JENSEN. (A communication from abroad by Thomas Alva Edison, of Menlo Park, America.) Dated September 24. 6d. Where many translating devices converting electricity into either power or light are arranged upon the multiple arc or derived circuit system, it is essential that so far as possible an equal electromotive force or "pressure" be maintained in all parts of the system. When however each set of conductors are run out from the central station in a straight circuit containing a number of translating devices, the pressure, when a number of

devices are in operation, is apt to be greatest nearest the central station, and to diminish gradually towards the end of the conductors, this "drop" being due to the resistance of the main conductors. The object of



this invention is to obviate such irregularity, and to maintain practically throughout the entire system an equal pressure. This is accomplished by using the conductors leading directly from the source of energy as feeding conductors only, placing no lamps ordinarily in the circuit connected directly to the source, placing the lamps or translating devices upon service or lamp circuits which connect to, and are fed by, the feeding conductors, in such manner that all the lamp circuits are electrically distant substantially from the source of electricity by the same mass of conductor. By so doing the greater portion, if not all, the drop occurs in the feeding conductors, the pressure in the service or lamp circuits being practically uniform at all points. The figure shows one method of carrying out the arrangement. (In this figure the main conductors, although shown of uniform thickness, in reality are made larger at their home ends, gradually tapering at the outer end of the system.)

3928. "Improvements in apparatus for generating and utilising electricity." WILLIAM ROBERT LAKE. (A communication from abroad by Elihu Thomson, of America.) Dated September 28. 8d. Relates to improvements in apparatus for the generation and utilisation of electricity by means of magneto and dynamo-electric machines of improved construction, whereby a very high electromotive force is obtained with the advantages of lightness, compactness, and durability. In figs. 1 and 2, N represents a hollow shell or cylinder of iron constituting one pole of the field magnet. The

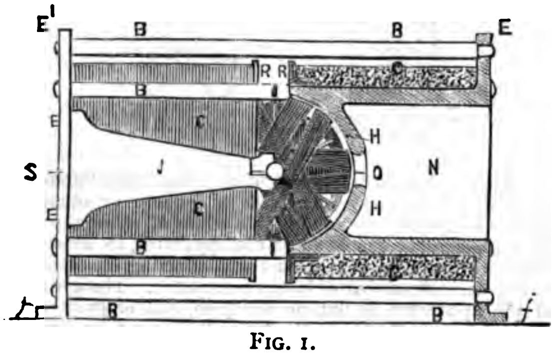


FIG. 1.

outer edge, F, of this cylinder is flanged, and its inner face, H, is shaped to conform to the circular outline of the armature of the machine as shown. If desired, a solid cylinder may be used instead of a hollow one. An opening (or openings) through the face, H, is provided, as at O, to allow the circulation of air through the centre of the shell, N. A similar shell of iron, S, is placed opposite to the said shell, N, and is also flanged, as shown at F'; this shell, S, constitutes the opposites pole of the field magnet. In the figure the shell, S, is shown covered by its coil, C', C'. Bars or pieces of iron, B, B, serve to connect the flanges, F, F', and are preferably let into holes in the latter; these bars are of sufficient number and size to make thorough magnetic contact between the aforesaid flanges, F, F'. The coils of insulated wire, C, C, and C', C', surround the field magnet poles, N and S, and also the armature of the machine, and serve for the direct magnetisation of the said poles, and of the armature itself. Rings, R, R, of metal or other suitable material, may be provided to keep the coils, C, C, and C', C', in place, since in most cases the latter project beyond the poles, N and S, and over the armature. If desired, the two coils, C, C, C', C', may be combined to form a single coil. The electric current traversing the coils, C and C', for magnetisation, travels in the same direction in both coils, and may be derived either from the machine itself, or from any other suitable source; the opposing faces of the poles, N and S, are thereby magnetised with opposite polarities. The bars, B, are situated near the outside of the coils, C, C', and are therefore magnetised by the said

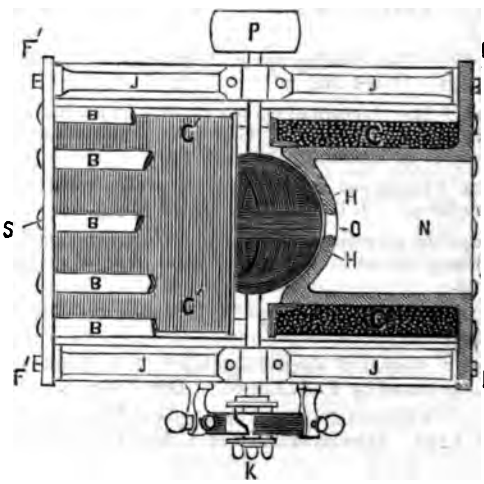


FIG. 2.

coils, the direction of their magnetisation being such as to intensify the magnetisation of the poles, N and S. The opposing faces, H, H, of the said magnets, N and S, between which faces the armature revolves, form, as shown, portions of a hollow sphere, the armature itself when wound with wire being spherical in outline. J represents a portion of the arm supporting the journals of the shaft of the armature, and f, f', are the feet of the machine. The armature employed in the present invention is spherical in form, as above stated, this form being found to possess great advantages.

Correspondence.

DESTRUCTION BY LIGHTNING.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—The accident which occurred on the 26th ult., at the Board School in Orange Street, Southwark, is another proof to me how little care is taken, even by such institutions (otherwise so well managed) as the

London School Board, to protect life and property against the destructive influences of the fiery flashes from the clouds. It is more than a century since Benjamin Franklin showed us the simple method of protection against lightning, and it may seem almost incredible that hundreds of buildings are still annually destroyed, and hundreds of lives lost by these discharges of electricity. I have just received an official letter from the Minister of Agriculture, Industry, and Commerce, of Italy, informing me that during the 16 years from 1864 to 1879 no fewer than 1,906 lives were lost in that country through fatal accidents from lightning. I beg to append a list of these casualties, as I received them from Rome. Can meteorological influences be traced to the astounding preponderance of accidents in certain years, such as 1868 and 1873?

I am, &c.,
RICHARD ANDERSON.

Rose Cottage, New Malden,
Surrey.
2nd May, 1881.

Deaths caused by lightning in Italy in the years 1864—1879:—

Years.	Deaths per Year.	Males.	Females.
1864	91	72	19
1865	76	54	22
1866	54	43	11
1867	98	62	36
1868	237	186	51
1869	109	79	30
1870	110	75	35
1871	99	76	23
1872	134	101	33
1873	184	136	48
1874	167	128	39
1875	137	96	41
1876	147	114	33
1877	92	66	26
1878	100	82	18
1879	71	52	19
Total	1,906	1,422	484

NAPIER'S SPEED MEASURER.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—In answer to Mr. Moritz Kohn's letter, desiring information respecting Napier's speed measurer, which was used by Mr. Schwendler in his experiments, I may say that although the instrument satisfied all the purposes required, and was indeed invaluable in showing the exact speed at sight to the slightest variation, it was not in the form quite suited for the market, nor did it embody some important improvements which Mr. Napier has since been working out. As soon as the final forms of this instrument, for the various purposes to which it is applicable, are arranged, I shall be able to furnish you with a full description and explanatory drawings.

Yours faithfully,
SHOWSPEED.

THE COLOUR OF THE ELECTRIC LIGHT.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—Your correspondent "Electron" remarks on the colour of the electric lights now at work in the City. Having given special attention to this subject, I hope you will allow me to trespass on your valuable space with a few remarks. First, as regards the Brockie system, to which he justly says "the highest encomium is paid," I consider, with all due allowance for the excellence of the Gramme machine, that the success is mainly due to the carbons, which are a special make of the Electric Carbon Company of London. Having noticed the unpleasant effect of the blue light in the electric arc, I experimented for some time as to the best way of improving the light, and I found this could be done in three ways: first, by incorporating lime or magnesia with the carbons at the time of combustion. This partly takes place in the Jablochkoff candle, but with better result in a lamp of mine in which the electric arc is caused to impinge on a block of lime and produce a perfectly steady light. The second plan is by introducing such substances into the carbon, which, without interfering with the resistance, should tone the light and nullify the effect of the violet rays; this plan is carried out at Cannon Street Station. The third method is by colouring the glass globes with a suitable pigment, which should so colour the light that it almost resembles that from a powerful gas burner. Numerous experiments with coloured globes have been carried out with the view of lighting the picture galleries at South Kensington, for which purpose the electric light has hitherto not been found suitable. With suitably coloured globes I should have no hesitation in lighting the interior of any theatre, and besides a considerable saving of cost, could do away with that dangerous and unsightly gas furnace—the sun burner. Curiously enough the carbons used in the four systems noticed by your correspondent are each made in different countries. The Jablochkoff candle comes from France, the Siemens from Germany, the Brush from America, and lastly those used with the Gramme are of home production, the quality of which we have no reason to be ashamed of.

Your obedient servant,
KILLINGWORTH HEDGES, C.E.

25, Queen Anne's Gate, Westminster.
May 7th, 1881.

HENLEY'S OZOKERIT CABLE CORE.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—It may be of interest to you to know that my company has secured a contract from the Compagnie de Télégraphie Sous-Marine de l'Amérique Centrale for the manufacture and laying of a submarine telegraph cable of about 400 miles, to be laid from Belize (British Honduras) to the island of Cuba. By means of this cable and its tributary land lines all Central America will be telegraphically connected with the United States and Europe. It is now being made at our works, and arrangements have been entered into for its being laid during the ensuing summer.

I may mention that my patent ozokerited core will be used; the insulation of this core is ten times higher than gutta-percha, as proved by Mr. Preece of the General Post-Office, and it is coming largely into use for telephones, torpedo cables, &c., &c.

I am, Sir, yours truly,
(For W. T. HENLEY),
Managing Director.
G. S.

8, Draper's Gardens, Throgmorton Street,
April 30th.

P.S.—I inclose a copy of Mr. Preece's report for your perusal.

[COPY.]

GENERAL POST OFFICE,
5th April, 1881.

DEAR SIR.—I have much pleasure in forwarding to you the following results of the tests we have made of the ten miles of ozokerit core which you recently supplied to the department.

Conductor resistance	23·723 ohms.
Capacity	·281 mf.
Insulation	8,196 megohms.
Temperature	75° Fah.

TESTS OF GUTTA-PERCHA CORE OF SIMILAR LENGTHS.

Conductor resistance	22·36
Capacity	·273 mf.
Insulation	860 megohms.
Temperature	75° Fah.

It will be seen from the above that the quality of your core compares very favourably with that of gutta-percha. It appears to deserve a trial as the core of a submarine cable.

I am,
Yours very truly,
(Signed) W. H. PREECE.

W. T. Henley, Esq.

Proceedings of Societies.

THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.

AN ordinary general meeting of this Society was held on Thursday, April 28th, Mr. LATIMER CLARK, vice-president, in the chair. The minutes of the last general meeting having been read and confirmed, and the list of new and proposed members read, the postponed discussion on Mr. St. George Lane Fox's paper on "The application of electricity to lighting and heating for domestic and other purposes" was opened.

Mr. SHOOLBRED said that it seemed to be overlooked in discussing Mr. Fox's paper, that arc as well as incandescence lights would have to be considered in dealing with the problem of general electric lighting. The incandescence lights possessed the great advantage of not requiring regulation like the arc lights. He thought that there would be considerable difficulty in getting the lamps of equal resistance. He would ask whether the earth was used as a return circuit. The meaning of subdivision he considered had been not clearly understood. Putting a number of lights in one circuit was not subdivision. There could be no doubt that the loss of light resulting from employing a number of lights as against a small number had been very much exaggerated, and was very much less than was at first stated; the actual loss was very slight.

Captain SALE, R.E., thought that the estimate of 160 candle-power per horse-power, per 1¾ lb. of coal, was not at all a fair estimate. In the case of gas, the price put upon it represented so many cubic feet delivered at the burners; in fact, the cost of the coal in electric lighting was by no means the only expense.

Mr. ALEXANDER SIEMENS contended that competition in electric lighting, as in everything else, was a great thing; he thought Mr. Fox deprecated this. With regard to Mr. Fox's theory to explain the action of electricity, he could not see the use of employing it in the place of the ordinary theory, which was quite correct and comprehensible. He could not agree with Mr. Fox that incandescence lighting was the only one suitable for the purpose stated; he would undertake to light with arc lights if he were asked to do so. The earth, he might mention, was often employed as a return circuit, but it was very essential that it should be thoroughly good. Opinions as regards subdivision had decidedly changed. The question of storing up energy had often been spoken of; this was effected in reality if the engine fires were banked up, as the energy then remained stored in the coal.

Mr. DONOVAN asked in what respect Mr. Fox's lamp differed from Swan's; the two seemed almost exactly alike.

Mr. C. F. VARLEY said that the views which had been expressed as to electricity being like a compressible fluid were quite incorrect. Faraday had thoroughly examined the question, and had come to the conclusion that electricity was quite incompressible. Electricity was a vehicle of force, not a form of latent energy. The calculations as to the resistance of the lamps he did not consider correct; the resistance was 45 per cent. less when hot than when cold.

Mr. R. E. CROMPTON said that the incandescence lamps could be made to any resistance required. As regards the cost of engine power, he would point out that one engine would not do the work required, and several small engines cost proportionately more than one large one. He did not think that the consumption of coal could be estimated at less than 2½ lbs. per horse-power per hour.

Professor PERRY pointed out that light was not energy only. This the equation to the force showed.

Mr. HEINRICHS said that although Mr. Fox's lamps were in many respects the same as those of Swan and Edison, yet the fact that there were certain small points of difference entitled them to be considered as improvements, as in any other invention.

Mr. BETTS considered that great confusion existed in the definitions of the terms "series," "multiple," "arc," &c. He thought it highly advisable that the terms should be more clearly defined.

After a few remarks by Professor AYRTON, Mr. LANE FOX rose to reply:—With reference to the exact cost of lighting a house by his system, it was impossible to give a definite answer, as so much depended upon details. While paying a great tribute to Mr. Edison for his work, which he considered had been chiefly beneficial by the excitement it had created, he would point out that his own patents were prior to those of Edison. The arranging of lamps in quantity or in series really depended entirely upon the arrangement of the wires and the resistance, &c., of the dynamo machines, both systems could be made to answer equally well if necessary. His paper was more particularly read for the purpose of eliciting a discussion and not for bringing forward a perfect system of electric lighting. The practicability of coupling up dynamo machines in multiple arc had been doubted, but he believed Mr. Edison had practically done this. If engines of 1000 horse-power were employed, they could certainly be worked with an expenditure of 1½lb. of coal per horse-power per hour. He thought that the electric light would open up a great field for unemployed labour. Arc lights, he considered, would disappear altogether in time, as the cost of the carbon electrodes was a serious item of expense. Captain Sale's remarks he did not agree with. He quite thought, with Mr. Betts, that the definitions of the terms he referred to might be put clear with advantage. In reply to a question with reference to the electric regulator, he would state that the idea was purely diagrammatic, and required to be practically worked out.

The meeting then adjourned.

City Notes.

Old Broad Street, May 11th, 1881.

INDO-EUROPEAN TELEGRAPH COMPANY.—The fourteenth ordinary general meeting of the shareholders of this Company was held on April 28th, at the New Exchange-buildings, George-yard, Lombard-street, Colonel J. Holland in the chair. The chairman moved the adoption of the report, a resolution which was seconded by Mr. D. Barlow. The chairman said that, before putting the resolution to the meeting, he would like to make a few observations. When affairs were reasonably prosperous reports were short, and in proportion the main facts were contracted in a few words. They had earned £12,000 more gross profits than they did in the preceding year, while their outlay had only been about £600 additional. He thought the proprietors would admit that that was a very satisfactory result. The details of the expenditure were set forth in the revenue account, and any further information he would be happy to give. Sundry creditors and sundry debtors were the two largest figures, the former amounting to £12,975, and the latter to £30,896. The whole of those, however, had run off. They were running accounts which were kept on both sides. They had to pay certain sums to various companies and constituents, and they had to receive various sums in a like manner. On examining the list of unsettled accounts for the last month they found only one item, and that was £700 due from the Secretary of State for India, and therefore they were pretty well posted up; and, so far as they knew and so far as Mr. Andrews knew, there was not a single bad debt. Before recommending a dividend, the directors had determined to lay aside a certain sum. Thus they had set aside £7,500 to reserve, which he thought the shareholders would agree was a substantial figure. Their relations with their customers and with other companies with whom they had business transactions, continued to be cordial, and there was every reason to hope that they would continue so. The report also referred to the appointment of Mr. Andrews as managing director (hear, hear). He was glad to hear that expression of approval, although he never doubted for a moment that the shareholders would be gratified by the announcement. Mr. Andrews' duties remained the same as before, and the appointment was really a complimentary notice of his exertions. The change, however, placed him in a better position with regard to other companies and the Governments associated with them. The board had felt that anything they could do to raise or improve Mr. Andrews' position was not only a pleasure but a duty, and they also felt it their duty to communicate with the Governments of Germany and Russia the fact that Mr. Andrews had been appointed managing director, and from the representatives of those Governments replies had been received which he desired to read, because Mr. Andrews had been obliged to be in constant communication with them. The present German Minister of Posts and Telegraphs, his Excellency Dr. Stephan, wrote as follows:—"I have been informed that the board of the Indo-European Telegraph Company have appointed you managing director. Permit me to express to you my congratulations upon this event. Since I had the pleasure of making your personal acquaintance at St. Petersburg in 1875, the judicious and intelligent conferences then engaged with you upon administrative and tariff questions embraced in the subject of telegraphy have always been a pleasant remembrance to me. I am convinced that the choice of the board could not have fallen upon a more competent and worthy gentleman, and I congratulate the Company on their having you at their head as managing director. Accept the expression of my particularly high esteem." On the same subject, his Excellency General von Lüeders, the Director-General of the Imperial Russian Telegraphs, wrote:—"I have received your communication of the 31st of March, sub No. 2686, and I am much pleased that your services in the skilful management of the Company's business, and in the maintenance of the Company's interests, have been acknowledged by your appointment to the managing directorship. At the same time I beg to send you my sincere congratulation upon this promotion, and hope that the good relations hitherto existing with my Government will continue unaltered. I take this opportunity to assure you of my continued high esteem." Mr. Grimstone expressed satisfaction at the past position of the Company, and the prospects held out for the future. He was also pleased to find that the board had acted upon a sound principle in building up a reserve and laying the foundation for the prosperity of the Company. The consequence of this had been that each half year their property had become more valuable. The chairman said that the policy which Mr. Grimstone approved of was the policy which that gentleman inaugurated when he was at the board. Although there was no particular reason for supposing that the result of the present year might not be so good as that of the past, still it might not be so, as they had done a great deal of business with the Government, owing to the Candahar question. In view of such possible fluctuations, it was thought desirable to keep the dividend at its present figure, and divide anything beyond in the shape of a bonus. The resolution for the adoption of the report was carried unanimously, and the dividend therein recommended was declared. The directors having been authorised to contribute to the servants' assurance endowment and pension fund, in accordance with the intimation contained in the report, the retiring directors, Messrs. W. H. Barlow, A. Delbruck, and J. B. Gossler, and the retiring auditors, Messrs. Kemp, Ford, & Co., were unanimously re-elected, and the meeting closed with a vote of thanks to the chairman and directors.

SUBMARINE CABLES TRUST.—The tenth annual ordinary meeting of the certificate holders in this trust took place on May 3rd, at No. 66, Old Broad-street. Mr. J. Pender, M.P., presided. The accounts for the financial year submitted showed that the revenue for the twelve months, including the balance brought from last year's accounts, viz., £2,539 11s. 7d., and the dividend on the Eastern Extension Shares (£1,696) referred to in the last report, amounted to £25,913 9s. 4d. The expenses of the trust, including the sum of £303 18s. 1d. legal charges in excess of the amount already reserved for the purpose, amounted to £1,647 18s. 6d. Payment of two coupons at the usual rate of 6 per cent. per annum had absorbed £20,442, the sum of £3,046 7s. 1d. has been transferred to the "redemption fund," and the balance of £777 3s. carried forward. From the report it appeared that by the trust deed authority was given to the trustees to sell any of the securities held by the trust when they could do so at a profit of 30 per cent. above cost price. During last year the trustees had sold 300 shares in the Eastern Extension Company at a fraction under par, making a profit on the sale of over 40 per cent. The amount realised was invested in the purchase of Submarine Cable Trust Certificates. The chairman, in moving the adoption of the report and statement of

accounts, said they had commenced the year with the very substantial balance of £2,539, which was increased by £1,696, being the dividend on the Eastern Telegraph share which had been earned in the previous year. The law expenses during the year had been higher than in the year before, and they had been temporarily placed in the Court of Chancery. The condition of the certificates had been somewhat affected by the competition, but since the 1st of October this had been recovered, and since which time the Anglo-American had been earning fair dividends. Further competition was projected, and, if not avoided, might, for a time, adversely affect their revenue. In consequence of the illness of Mr. William Newmarch, one of the auditors appointed at the last annual meeting of certificate holders, the accounts presented bore the signature of only one auditor—viz., Mr. J. G. Griffiths. Mr. Newmarch had been seriously ill, and therefore unable to attend to his duties. He was, however, better now, and he trusted that the certificate holders would again elect him to the post of auditor. In reply to a question, the chairman said he did not know of any opposition except from Mr. Jay Gould, who said he wished to rate New York the centre of telegraphy. It had been said that half a dozen companies were likely to crop up, but he only knew of this one. The report was then adopted unanimously. Mr. W. Newmarch and Mr. J. G. Griffiths were then re-elected auditors for the ensuing year, which concluded the business of the meeting. A vote of thanks to the chairman closed the proceedings.

THE board of the Direct United States Cable Company have resolved upon the payment of an interim dividend of 5s. per share, being at the rate of 5 per cent. per annum for the quarter ended March 31st, 1881.

THE WEST INDIA AND PANAMA TELEGRAPH COMPANY (LIMITED.)—The report of the directors to be presented at the eighth ordinary general meeting of members, to be held on 18th May, 1881, contains the accounts for the six months ending 31st December, 1880, and states that the receipts for the half-year amounted to £19,694 11s. 3d. To this is added £5,841 12s. 9d. brought from last half-year's accounts, and £5,372 4s. 11d., an amount set aside in previous periods in respect of depreciation of the s.s. *Investigator*, no longer required, making a total to the credit of revenue account of £30,908 8s. 11d. The expenses have amounted to £28,952 3s. 2d., leaving £1,956 5s. 9d. to be carried forward to the credit of next half-year's account. The falling-off in the amount of traffic receipts and subsidies has arisen from two causes, viz., the interruptions to the Company's cables, and the accumulation of breaks pending the despatch of the steamers *Grappler* and *Duchess of Marlborough* to replace the disabled steamers *Investigator* and *Caroline*. At the date of the last report nine cables were interrupted, and since that time four other interruptions have occurred. Nine of these have been successfully repaired, and the directors are glad to report that only one section is now interrupted which affects telegraphic communication, viz., that between Trinidad and Demerara. It is therefore hoped that the traffic will now revert to its normal proportions.

The following are the final quotations of telegraphs:—Anglo-American, Limited, 56½-57; Ditto, Preferred, 87-88; Ditto, Deferred, 28½-29; Black Sea, Limited, ——; Brazilian Submarine, Limited, 10¼-10¾; Consolidated Telephone Construction, 4s. 6d. to 5s. 6d. pm.; Cuba, Limited, 9-9½; Cuba, Limited, 10 per cent. Preference, 16½-17; Direct Spanish, Limited, 3¾-4¼; Direct Spanish, 10 per cent. Preference, 13-14; Direct United States Cable, Limited, 1877, 11½-11¾; Scrip of Debentures, 101-104; Eastern, Limited, 9¾-10¼; Eastern 6 per cent. Preference, 12¾-13; Eastern, 6 per cent. Debentures, repayable October, 1883, 103-106; Eastern 5 per cent. Debentures, repayable August, 1887, 103-105; Eastern, 5 per cent., repayable Aug., 1899, 105-108; Eastern Extension, Australasian and China, Limited, 11-11½; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 109-112; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 105-107; Ditto, registered, repayable 1900, 105-107; Ditto, 5 per cent. Debenture, 1890, 100-103; Eastern and South African, Limited, 5 per cent. Mortgage Debentures, redeemable 1900, 103-106; Ditto, ditto, to bearer, 103-106; German Union Telegraph and Trust, 11¾-12¼; Globe Telegraph and Trust, Limited, 6¼-6½; Globe, 6 per cent. Preference, 12¾-12¼; Great Northern, 12¼-11½; 5 per cent. Debentures, 103-106; Indo-European, Limited, 29-30; London Platino-Brazilian, Limited, 6¼-6¾; Mediterranean Extension, Limited, 2¼-2¾; Mediterranean Extension, 8 per cent. Preference, 9¾-10¼; Oriental Telephone, ⅛ dis. to par; Reuter's Limited, 11-12; Submarine, 270-290; Submarine Scrip, 2⅛-2⅜; Submarine Cables Trust, 101-104; United Telephone Company, 7½-8½; West Coast of America, Limited, 4½-5; West India and Panama, Limited, 2-2½; Ditto, 6 per cent. First Preference, 7-7½; Ditto, ditto, Second Preference, 6-6½; Western and Brazilian, Limited, 8¾-8¾; Ditto, 6 per cent. Debentures "A," 104-108; Ditto, ditto, ditto, "B," 98-102; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 120-125; Ditto, 6 per cent. Sterling Bonds, 104-108; Telegraph Construction and Maintenance, Limited, 31-31½; Ditto, 6 per cent. Bonds, 107-110; Ditto, Second Bonus Trust Certificates, 3¾-4; India Rubber Company, 20-21; Ditto, 6 per cent. Debenture, 105-109.

TRAFFIC RECEIPTS.

NAME OF COMPANY.		MARCH.	APRIL.	REMARKS.
		£	£	
Anglo-American...	1881	51,540	43,980	
	1880	*40,290*	*41,580*	
Brazilian S'marine	1881	15,762	15,538	
	1880	*13,279*	*15,525*	
Cie. Française ...	1881	...	...	Not published.
	1880	..	..	
Cuba Submarine...	1881	3,100	3,100	Feb estimated at £2,900, realised £2,867.
	1880	*3,588*	*3,139*	
Direct Spanish ...	1881	1,492	1,337	
	1880	..	*1,453*	
Direct U. States ...	1881	17,180	14,660	
	1880	*13,430*	..	
Eastern	1881	51,206	45,289	
	1880	*43,374*	*44,748*	
Eastern Extension	1881	29,661	26,746	
	1880	*26,485*	*24,348*	
Great Northern ...	1881	18,520	17,720	
	1880	*16,440*	*18,380*	
Indo-European ...	1881	...	...	Not published.
	1880	..	..	
Submarine	1881	...	...	Publication temporarily suspended.
	1880	..	..	
W. Coast America	1881	...	...	
	1880	*1,775*	..	
West. & Brazilian	1881	10,797	10,484	
	1880	*9,908*	*11,302*	
West India	1881	5,050	5,470	Dec. receipts realised £3,28[illegible]; those for Jan. £4,33[illegible].
	1880	*6,559*	*4,535*	

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MOLECULAR MAGNETISM.

PROFESSOR D. E. HUGHES, F.R.S.
leceived May 10th, 1881, read May 19th.)

e course of some late researches, which I nour to communicate to the Royal Society, ,* and experimentally illustrate on the read- second paper, March 31st,† so many experi- ts occurred, all pointing to the conclusion ury molar magnetism is entirely due to the il arrangement of its polarised molecules, iese molecules can be rotated by torsion, so ease its longitudinal magnetism, or increase ffect of the elastic torsion is to rotate the in its required longitudinal symmetrical nt, and observing that molecular magnetism ce an electric current upon its own molar :s, or that an electric current by its passage i iron wire would produce molecular mag- iave continued these researches in the hope :ing, as far as possible, the phenomenon of ormation of electricity and magnetism by the produced in the molecular structure of its ; wire.

s purpose I have employed three separate of investigation, each requiring a slightly 'orm of apparatus. The first relates to the of an elastic torsion upon a magnetic or con- re; the second, the influence upon the mole- cture of an iron wire by electricity or mag- he third was the evident movement of the themselves as given out in sonorous vibra-

:neral details of the apparatus employed :en given in my paper of March 7th, I will ly indicate any modification of the method

ice of an Elastic Torsion upon a Magnetic or an Electric Conducting Wire.

paper of March 7th on "Molecular Electro- Induction," I showed that induced currents :ity would be induced in an iron wire placed ixis of a coil through which intermittent were passing, and that these currents were only when the wire was under the influence on not passing its limit of elasticity. It be- dent that if the intermittent magnetism in- the coil produced under torsion intermittent of electricity, that an intermittent torsion : influence of a constant current of electricity stant magnetic field would produce similar This was found to be the case, and as some omena presented themselves indicating clearly cular nature of the actions, I will describe a hem directly relating to the subject of this

:cular Electro-Magnetic Induction," March 7th 1881. GRAPHIC JOURNAL, April 1st and 15th, 1881.)
ianent Molecular Torsion of Conducting Wires produced sage of an Electric Current," March 17th, 1881. (See HIC JOURNAL April 15th, 1881.)

The apparatus used was similar to that described in my paper of March 7th. An iron wire of 20 centims. was placed in the centre or axis of a coil of silk-covered copper wire, the exterior diameter of the coil being 5½ centims., having an interior vacant circular space of 3⅛ centims. The iron wire is fastened to a support at one end, the other passing through a guide, to keep it parallel but free, so that any required torsion may be given to the wire by means of a connecting arm or index. A sensitive telephone is in direct communication with the coil, or a galvanometer may be used, as the currents obtained by a slow elastic torsion are slow and strong enough to be seen on a very ordinary galvanometer. I prefer, however, the telephone, because it has the inestimable advantage in these experiments of giving the exact time of the commencement or finish of an electric current. It has, however, the disadvantage of not indicating the force or direction of the current; but by means of the sonometer the true value and direction of any current is at once given. Again, the telephone is useless for currents of slow intermittence, but by joining to it the microphonic rheostat described in my paper of March 7th, a slowly intermittent or permanent current is broken up into rapid intermittent currents, and then we are able to perceive feeble constant currents. For this reason a microphonic rheostat is joined to the telephone and coil. The current from a battery of two bichromate cells is sent constantly through the wire if we wish to observe the influence of the torsion of the wire upon the electric current, or a constant field of magnetic energy is given to the wire by either a separate coil or a permanent magnet. The currents obtained in the coil are induced from the change in the molecular magnetism of the wire, but we may equally obtain these currents on the wire itself without any coil by joining the telephone and rheotome direct to the wire; in the latter case it is preferable to join the wire to the primary of a small induction coil, and the telephone and rheotome upon the secondary, as then the rheotome does not interrupt the constant electric current passing through the wire. As the results are identical, I prefer to place the telephone on the coil first named, as the tones are louder and entirely free from errors of experimentation.

If we place a copper wire in the axis of the coil, we produce no effect by torsion, either when under the influence of a constant magnetic field or a current passing through it, nor do we perceive any effects if we place an iron wire (2 millms. in diameter), entirely free from magnetism and through which an electric current has never passed. I mention this negative experiment in order to prove that all the effects I shall mention are obtained only through the magnetism of the wire. If now I pass an electric current for an instant through this same wire, its molecules are instantly polarised, and I have never yet been able to restore the wire to its original condition, and the magnetisation induced by the passage of a current is far more powerful and more persistent in soft iron than tempered steel. This may be due, however, to the fact that in tempered or softened steel we find traces only of a current during the rotation by torsion of its molecules, some two to three degrees of sonometer, whilst iron gives constantly a current of 70 sonometric degrees.*

In order to obtain these currents, we must give a slight torsion of 5° or 10° to and fro between its zero point. We then have a current during the motion of the index to the right, and a contrary current in moving the index to the left. If we use a galvanometer, we must time these movements with the

* 0·8 of a Daniell battery.

oscillations of the needle; but with the telephone it gives out continuous sounds for either movement, the interruptions being only those caused by the rheotome. The direction of the current has no influence on the result; either positive to the free arm or index or negative gives equal sounds, but at the moment of reversal of the current a peculiar loud click is heard, due to the rapid change or rotation of the polarisation of its molecules, and this peculiarly loud momentary click is heard equally as well in steel as in iron, proving that it is equally polarised by the current, but that its molecular rigidity prevents rotation by torsion. We can imitate in some degree the rigidity of steel by giving the iron wire several permanent twists. The current due to elastic torsion is then reduced from 70° to 40°, due to the mechanical strain of the twists remaining a constant; and a weakening of the current is also remarked if with a fresh wire we pass in torsion its limit of elasticity.

If a new soft iron wire of 2 millims. (giving no traces of a current by torsion) has passed through it a momentary current of electricity, and then were observed free from the current itself, it will be found to be almost as strongly polarised as when the current was constantly on, giving by torsion a constant of 50 sonometric degrees. If, instead of passing a current through this new wire, I magnetise it strongly by a permanent magnet or coil, the longitudinal magnetism gives also 70° of current for the first torsion, but weakens rapidly, so that in a few contrary torsions only traces of a current remain, and we find also its longitudinal magnetism almost entirely dissipated. Thus there is this remarkable difference, and it is that whilst it is almost impossible to free the wire from the influence produced by a current, the longitudinal magnetism yields at once to a few torsions. We may, however, transform the ring or transversal magnetism into longitudinal magnetism by strongly magnetising the wire after a current has passed through it; this has had the effect of rotating the whole of the molecules, and they are all now symmetrical with longitudinal magnetism, then by a few torsions the wire is almost as free as a new wire; and I have found this method more efficacious than heating the wire red hot, or any other method yet tried. If I desire a constant current from longitudinal magnetism, I place at one of the extremities of the wire a large permanent magnet, whose sustaining power is 5 kilogrammes, and this keeps the wire constantly charged, resembling in some respects the effects of a constant current. The molecular magnetism or the current obtained by torsion is not so powerful from this, my strongest magnet, as that produced by the simple passage of a current, being only 50 sonometric degrees in place of 70° for that due to the passage of a current. The mere twisting of a longitudinal magnet, without regard to the rotation of its molecule having no effect, is proved by giving torsion to a steel wire strongly magnetised, when only traces of a current will be seen, perhaps one or two degrees, and a constant source of magnetism or electricity then giving no measurable effect. Evidently we have equally twisted the magnetised steel as the soft iron. In the steel we have a powerful magnet, in the soft iron a very feeble one; still the molecular rotation in iron produces powerful currents to the almost absolute zero of tempered steel.*

If we magnetise the wire whilst the current is passing, and keep the wire constantly charged with both magnetism and electricity, the currents are at once diminished from 70° to 30°. We have here two distinct magnetic polarisations at right angles to each other, and no matter what pole of the magnet or of the current the effect is greatly diminished; the rotation of the two polarities would now require a far greater arc than previously. The importance of this experiment cannot as yet be appreciated until we learn of the great molecular change which has really occurred, and which we observe here by simply diminished effects.

If we heat the wire with a spirit flame, we find the sounds increase rapidly from 70 to 90, being the maximum slightly below red heat. I have already remarked in my previous paper this increased molecular activity due to heat, and its effects will be more clearly demonstrated when we deal with the sounds produced by intermittent currents.

Another method, by means of which I have again received proofs of the rotation of the polarised molecule, is to pass an intermittent current through a soft 0·5 millim. iron wire, listening to the results by the telephone joined direct and alone to the coil, as described in my paper of March 7th. If, then, the wire is entirely free from strain, we have silence, but a torsion of 20° produces some 50 sonometric degrees of electric force. If, now (the wire being at zero strain), I bring one pole of the permanent magnet I have already described near the side of the wire, the sounds increase from zero up to 50°, being at their maximum when this magnet is 5 centims. distant; but if we continue to approach the magnet the sounds gradually weaken to an almost zero. The explanation of this fact can be found when we know that the greatest inductive effect on the wire would be when a magnet is at an angle of 45° with the wire. And, also, considering each molecule as a separate independent magnet, we find that at a given distance for a given magnet the force of rotation is equal to that of 45°; by approaching the magnet we increase the rotation but diminish the angular polarity in relation to the wire, hence the decrease of force by the near approach of the magnet. And to prove that the function of the elastic torsion is simply to rotate the polarised molecules similarly to the magnet, we place the wire under an elastic torsion of 20°, and approach gradually the magnet as before. One pole now will be found to increase the sounds or its angular polarity, the other will decrease until at 5 centims. distance as before we have perfect silence; the torsion exists as before, but the molecules are no longer at the same angle. On removing the magnet we find that instead of the usual 50 of current we obtain barely 5 or 10; have we then destroyed the polarity of the molecules, or do they find a certain resistance to their free rotation to their usual place? To solve this question we have only to shake or give the wire a slight mechanical vibration, and then instantly the molecules rotate more freely, and we at once find our original current of 50°. I will forbear mentioning many other experimental proofs of my views by this method, as there are many to relate by different methods in the following chapters.

2. *Influence upon the Molecular Structure of an Iron or Steel Wire by Electricity or Magnetism.*

Being desirous to modify the apparatus already described, so that it would only give indications of a current if they were of a spiral nature, the wire was kept rigidly at its zero of strain or torsion, and the coil was made so that it could revolve on an axis perpendicular to the wire; by this means, if the wire was free from strain, the centre or axis of the coil would coincide with that of the wire. Thus, with a straight copper wire, we should have a complete zero, but if

* I purposely avoid using the terms "magnetic fluid" and "coercitive force."

this wire formed a right or left-handed helix, the coil would require moving through a given degree (on an arbitary scale) corresponding to the diameter and closeness of the spirals in the helix; the degrees through which the coil moved were calibrated in reference to known copper helices. 50° equalled a copper wire 1 millim. diameter, formed into a helix of 1 centim. diameter, whose spiral turns were separated 1 centim. apart.

In order to obtain a perfect zero, and wide readings, with small angular movement of the coil, it is necessary that the return wire should be of copper, 2 millims. diameter, offering comparatively little resistance, and that it should be perfectly parallel with the steel or iron wire. In order that it may react upon the exterior of the coil, it is fastened to the board, so that it is near (1 centim.) the exterior of the coil, and parallel to the iron wire, at a distance of 4 centims. If we consider this return wire alone, we find, as in the sonometer, that if the wire is perpendicular to the exterior wires of the coil, we have a zero or silence, but moved through any degree, we have a current proportionable to that degree; by this means we have an independent constant acting on the coil, constantly aiding the coil in finding its true zero, and allows of very wide readings, with a comparatively small angular movement of the coil.

The rheotome is joined to a battery of two bichromate cells, and by means of a reversing switch an intermittent current of either direction can be sent through the wire. The telephone is joined direct and alone to the coil, thus no currents react upon the coil when perpendicular to the iron, and its return wire, if not of a spiral nature.

Placing an iron wire 0·5 diameter, and passing a current through it, I found a change had taken place similar to those indicated in my paper of March 17th; but it was so difficult to keep the wire free from magnetism and slight molecular strains that I preferred and used only in the following experiments tempered steel wire (knitting needles I found most useful). All the effects are greatly augmented by the use of iron wire, but its molecular elasticity is so great that we cannot preserve the same zero of reading for a few seconds together, whilst with steel, 0·5 millim. diameter, the effects remained a constant until we removed the cause.

I have not as yet been able to obtain a steel wire entirely free from magnetism, and as magnetism in steel has a remarkable power over the direction of the spiral currents, I will first consider those in which I found only traces. On passing the intermittent current through these, the sounds were excessively feeble for either polarity of current, but at each reversal a single loud click could be heard, showing the instant reversal of the molecular polarity. The degree of coil indicating the twist or spirality of the current was 5° on each side of its true zero. The wire was now carefully magnetised, giving 10° on each side for different currents. The positive entering at north pole indicating 10° right-handed spiral, negative entering the same pole, a left-handed spiral, we here see in another form a fact well known and demonstrated by De la Rive by a different method, that an electric current travels in spirals around a longitudinal magnet, and that the direction of this spiral is entirely due to which pole of an electric current enters the north or south pole. I propose soon, however, to show that under certain conditions these effects are entirely reversed.

If through this magnetised wire I pass a constant current of two bichromate cells, and at the same time an intermittent one, the spiral is *increased to* 15°, but the direction *of the intermittent current entirely* depends on that of the constant current; thus, if the positive of the constant current enters the north pole, the intermittent positive slightly increases the spiral to 17°, and the negative to 13°, both being right-handed; the two zeros of the constant battery are, however, as we might expect from the preceding experiment, on equal opposite sides of the true zero; but if we magnetise the wire whilst a constant current is passing through it, a very great molecular disturbance takes place; loud sounds are heard in the telephone, and it requires for each current a movement of the coil of 40°, or a total for the two currents of 80°. This, however, is not the only change that has taken place, as we now find that both constant currents have a right-handed spiral; the positive under which it was magnetised, a right-handed spiral of 95°; the negative, a right-handed spiral of 15°, and the true central or zero point of the true currents indicates a permanent spiral of 55°.

This wire was magnetised in the usual way, by drawing the north pole of my magnet from the centre to one extremity, the south from the centre to the other, and this repeated until its maximum effects were obtained; in this state I found, sliding the coil at different portions, that the spiral currents were equal, and in the same direction throughout.

(To be continued.)

MAICHE'S ELECTROPHONE.

WE understand that M. Maiche has recently been trying a new telephone or electrophone of his invention on the submarine cable between Dover and Calais, and also through the line between London to Dover, and that he has been able to carry on a conversation at this distance. Details of the invention and of the actual results of his experiments are not yet to hand, but the following description of an apparatus patented by M. Maiche affords, we have reason to believe, some information on the subject.

This invention relates to improvements in telephonic apparatus or "electrophones," and is designed for facilitating the transmission of sounds over long distances.

For this purpose the apparatus is combined with an ordinary telephone, which serves as a receiving instrument, repeating at a distance all the sounds that have acted upon the electrophone. The latter is very sensitive, and is provided with means for calling the attention of the person at the station or place with which communication is desired.

This improved apparatus or electrophone consists substantially of carbon contact-pieces mounted upon a bell or sonorous box or vessel of any suitable material (preferably glass), the contact-pieces or carbons being placed as near as possible to the edge of the bell or sonorous box. These carbon contact-pieces transform the sonorous vibrations of the substance of the bell in front of which the speaking is carried on into mechanical action, and the vibrations produce differences of pressure between the carbons, and consequently variations in the intensity of the current passing through the carbons. These variations of intensity produce induced currents in an induction coil, and these induced currents are transmitted along the line to actuate the receiving telephone.

By reason of a special arrangement, which dispenses with the necessity for employing an electric bell, the apparatus, together with its battery and a telephone, forms a complete set of mechanism for a station.

In figs. 1 and 2 A represents a wooden box or case, in which an aperture is made. This box incloses the bell or sonorous box or vessel, C, made preferably of glass. This vessel is open on one side. The space between the walls of the sonorous vessel and the wooden box or case, A, is filled up with wadding. Upon the sonorous vessel, C, are placed, one above the other, the contact-pieces made of carbon. These contact-pieces consist of one or several pairs of carbons, *a*, which are spherical in form, and which are arranged as near as possible to

The arrangement of the carbons upon the sonorous glass vessel is preferably that shown in fig. 3, in parallel rows, in which the carbons touch, and are connected by means of a wire. These rows support intermediate rows of cylindrical or prismatic carbons, the carbons being by this method connected for "quantity." As they bear upon each other by their own weight they are always properly regulated or adjusted, that is to say, the vibrations are always produced under the same conditions, and whatever may be their arrangement or number the working of the apparatus is the same.

The wooden box or case, A, upon which a small induction coil, E, is fixed, carries also a call-push, F, and a movable lever, G, which supports the telephone, H, and acts as a commutator.

FIG.3

FIG.1.

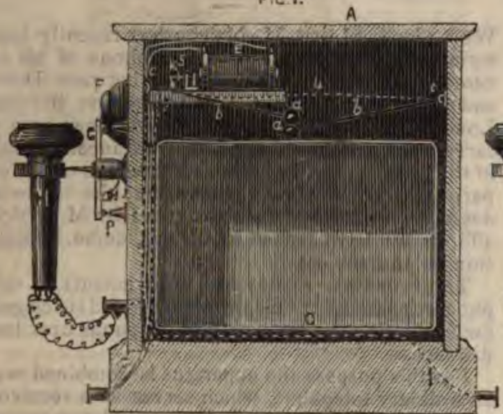
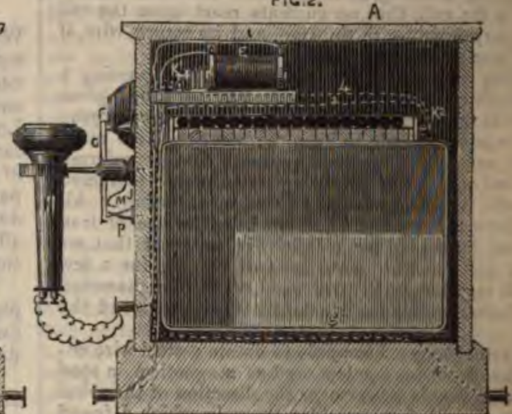


FIG.2.



the edge of the vessel, C, and in such a manner that their position may be regulated upon the end of metallic rods or stems, *b*, which are hinged at *c* to the walls of the wooden case or box inclosing the electrophone, and at these points, *c*, two wires, 2, 4, terminate; the current passes through the stems or rods. One of the carbon balls, *a*, by its own weight, bears against the sonorous glass bell or vessel, and the other carbon ball rests upon the first-named carbon ball in a like manner. For pressing the carbons against each other, and against the wall of the glass bell, flat springs may be used. The contact balls are either cut from blocks of carbon or they may be moulded.

The contact-pieces may consist of small pieces of carbon, R, either of cylindrical or prismatic form, arranged as shown in figs. 2 and 3, and carried in a wooden frame.

When the telephone is removed from its support, the circuit of the battery is closed through the primary wire of the induction coil and the microphone in the usual way.

When a person speaks in front of the aperture in the case the sonorous bell or vessel vibrates. The vibrations are imparted to the carbons, and produce variations in the resistance which the battery current meets with in passing through the whole of the carbons, and by these variations a series of induced currents is produced in the fine or induction wire of the coil, which currents following the line wire, 6, pass to and actuate the telephone of the station with which the electrophone is connected, in such a manner that all the sounds produced in the electrophone are repeated by the telephone with which it is connected.

The sonorous bell or vessel is insulated from the

wooden box or case by wadding or the like, as before stated, so that the former may not be affected by the vibrations of the box or case.

For attracting the attention of a person at the receiving station it is sufficient to press the button or push, F, the battery current then flows through the wires, 1, 7, 8, and consequently the induction coil is in the requisite condition for operating in the ordinary manner. The vibrator is thrown into rapid motion, and the induced currents rapidly repeated in the main wire act upon the telephone at the station with which communication is desired. At this station a loud humming sound is then heard, which is the signal calling attention. The same humming is heard in the telephone of the sending station. The electric bell is therefore dispensed with, and the action of the battery is altogether local. This is not the case with ordinary bell arrangements, for which batteries (sometimes very powerful ones) are rendered necesssary by the great distance between the stations.

The coil, which can be thus advantageously used instead of an electric bell, without necessitating the connection of the stations by means of a battery, has the further advantage of changing the battery current into a differential current of high tension, which is produced in the induction wire of the coil by the variations of intensity of the battery current consequent upon the vibrations of the carbons.

The coil employed may either be an ordinary coil with a soft iron core, or a coil in which the soft iron is acted upon by a permanent magnet, but preferably a coil is used in which the soft iron core is replaced by a permanent magnet, as the latter increases the sensitiveness of the apparatus.

ON A NEW CONTACT-BREAKER FOR INDUCTION COILS.

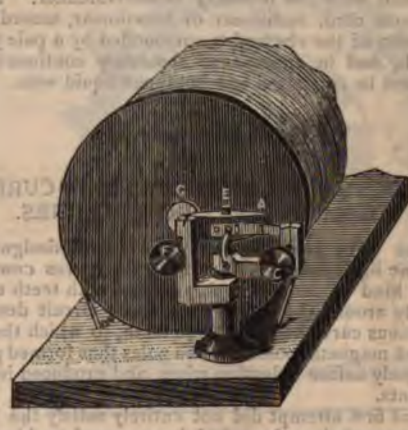
By MARCEL DEPREZ.

THE contact-breaker universally adopted in induction coils has been borrowed from that employed in electric bells; it is too well known to require description. In consequence of circumstances which it is unnecessary to relate, I was led some months ago to study very closely the manner in which it worked, and I saw that this rudimentary piece of mechanism presented numerous defects which resulted in a very considerable loss of efficiency in the coils to which it was applied; thus, when the induction current was closed, it did not acquire instantaneously its whole intensity, the increasing magnetisation, according to the mass which forms the bundle of iron wires, develops in effect a reverse electromotive force to that of the battery, so that, during a time which depends upon the power of the battery, upon the resistance of the inducing circuit, upon the number of turns which the wire makes round the iron bundle, and upon the mass of the latter, the intensity of the current passes through a series of successive values, which constitute a true variable state. In fact, at the end of a very short but definite time, the intensity of the current acquires its definite value, which is given by Ohm's law, and which depends only upon the electromotive force of the battery and upon the resistance of the circuit. It is evident that at the moment when this variable period comes to an end we must break *the inducing current in order* that the induced current may be as powerful as possible, for a prolonged closing of the inducing current would only increase the consumption of the zinc in the battery without producing any effect; besides, it would diminish the number of breaks, and consequently the number of induced currents in a given time. This is not what occurs with the ordinary contact-breaker. In consequence of the elasticity of the pieces which compose it, it has a great amplitude of vibration, during which the relative durations of the closing and of the breaking of the inducing circuit are completely arbitrary, and they have no connection whatever with the values, which they should have, in order to obtain from the coil the maximum effect. The considerations show that a good contact-breaker should satisfy the following conditions:—

1st. The breaking the current just at the end of the variable state.

2nd. The re-establishment in the shortest time possible after the break, so that the variable state of the break has a duration much shorter than the variable state of the closing.

All these conditions are fulfilled in the contact-breaker which I am about to describe, represented in the figure, and which is applied to coils constructed by M. Carpentier.



A is a little armature of soft iron, movable around a stout axis, B, which passes through the centre of A, One of its extremities is set opposite the end of the bundle of iron wires, and banks against a platinum-tipped screw. The inducing current arrives by this screw, traverses the armature to B, and continues its course by passing to the pivot, E, and by a little plate of flexible copper to the coil.

The antagonistic force is produced by a spring, R, attached at D to the armature, A, and which is regulated in tension by the screw, C.

The following is the action of the contact-breaker:—

When the current is closed, the magnetisation of the bundle passes, as has been explained, through all the values between zero and its maximum value, which it reaches in a very short time; it is at this moment that the attraction exercised upon the armature, A, becomes equal to the tension of the spring, and the slightest increase in this attraction determines the movement of the armature and consequently an immediate break of the current.

As the pieces against which the armature rests are extremely rigid, a very small movement of the latter causes a break in the circuit; but as soon as the break takes place, the spring, R, re-establishes contact between the armature, A, and the screw, F, in an extremely

short time, since the distance between the two pieces is inappreciable, and then the same action takes place again. If it is desired to obtain the most energetic effects possible, it will be necessary to give to the spring, R, a tension sufficient to completely paralyse the movement of the armature, A, and then to slacken it out, little by little, till the latter begins to vibrate. We can be certain then that the inducing current is only broken when the magnetisation of the iron bundle has attained its maximum value.

In one respect this contact-breaker is a true current measurer, inasmuch as it keeps the current closed till the moment when its intensity passes a certain value.

This is so true that if we give to the spring a tension decidedly less than the maximum attractive power of the soft-iron bundle, we can cause currents to circulate in the coil produced by a very powerful battery, so that the spark at the contact-breaker is scarcely appreciable. It is thus that I have been able to work a coil of very small size, destined to give sparks of a maximum length of 10 millimetres, with a battery of 10 Bunsen elements of the Ruhmkorff model, without the contact-breaker being damaged in any way. The induction spark in this case has an appearance entirely different from that which is obtained with coils provided with the ordinary contact-breaker. It is a luminous cord, rectilinear or curvilinear, according to the form of the electrodes, surrounded by a pale yellow sheath, and in appearance absolutely continuous. It can best be compared to a luminous liquid vein.

JABLOCHKOFF'S ALTERNATING CURRENT DYNAMO-ELECTRIC MACHINES.

ABOUT three years ago M. Jablochkoff designed an electric light machine. In principle it was composed of a kind of large wheel, provided with teeth set obliquely around the axle. An electric circuit described a sinuous curve between these teeth, to which they imparted magnetic polarity; the poles thus formed passed obliquely before induction wires, and produced induced currents.

This first attempt did not entirely satisfy the inventor; nevertheless the principle appeared to him to be worth further study, and we now find it re-invented and developed in the alternating current machine which M. Jablochkoff has constructed, and of which the working is, it appears, excellent.

The machines in use are undoubtedly very good, but each of them has some defect which distinguishes them. In the Siemens machine it is the inductor which turns; this alone is an inferiority; the collector is necessarily very complicated, subject to sparking, and the connection, so important with useful circuits, is less sure. In the Gramme machine the inductor is fixed, but its arrangement in the ring renders it inconvenient to construct and very difficult to repair. If an accident takes place during work, however small it is, the machine must be stopped and all work suspended. It must be added that the arrangement even of this ring is a disadvantage in the construction of large machines.

M. Jablochkoff wished to have a revolving inductor and a fixed inductor always visible, divided into independent parts, and repairable separately. The following is the way in which he arrived at this result:—

He preserves in his inducer the principle of the obliquity of induced polar surfaces, but he has diminished the diameter of the wheel, augmenting at the same time the height of the core magnets; the whole presents, therefore, the appearance of helicoidal fans fixed to the axis of rotation. Figs. 1 and 2 show exactly the arrangement; they represent the pieces of the machine with 16 bobbins which M. Jablochkoff has constructed and experimented on in Russia. This apparatus was made with the object of enabling a larger one to be made, to which we shall refer.

Fig. 1 is a front view, and fig. 2 a view of the side of the inductor. The fans thus arranged would undoubtedly be sufficiently difficult to construct in one piece of metal, but they are not made thus: they are formed of little plates of sheet iron, placed the one on the other, and clamped between two terminal plates, fixed by bolts; this mode of construction is clearly indicated in fig. 3, which shows in elevation the section of one of these fans, and in plan the view of the side.

The wires are wound around the cores thus formed; they are held by projections of the terminal plate, and joined in one circuit by arranging the junctions so that the upper surface of the fans forms poles of alternate polarities; the current is produced, and lead away by two rings with rubbers, which are seen to the left on the axis; the driving pullies are to the right. As can be seen, there are eight fans forming the electro-magnet in the machine which we represent.

The inducer is formed by flat bobbins, of which the core is composed, of little plates of sheet iron, in order to avoid residual magnetism, or what are known as faradaic currents. Each of these bobbins receives a coil of three layers of turns only, placed transversely, and, thus arranged, are fixed by the aid of a strap on the two cheeks in which the inducer turns. Figs. 3 and 4 show the section and view of the side of this very simple arrangement amongst others; the bobbins, which in this machine are 16 in number, do not touch; they have an interval between them of about 1 millim., by which the current of air produced by the rotation of the inducer can escape, thus producing a continual cooling effect. The bobbins are otherwise electrically distinct, and can be employed either separately or connected together, according to what is required. M. Jablochkoff has combined his machine so that each bobbin corresponds to a candle; it is possible, therefore, if this is useful, to have as many circuits as bobbins, each one of these being completely independent of the others; any of the combinations in quantity or in tension can be adopted if required. It is possible without difficulty to change the arrangement during work, and it is possible also (and this is very important), without stopping the machine, to cut out of circuit any one of the bobbins, and to replace it by a new one, the other bobbins, properly combined, and with a slight increase in speed given to the machine, doing the necessary work during the making of the change. This is a practical security of the highest kind which does not exist in any other machine.

One of the advantages which M. Jablochkoff refers to, is the arrangement which he adopts for the inducer, it is that to a small angular movement there corresponds a considerable displacement of the magnetic pole, which allows of the employment of low velocities. The machine which we represent does not require, it appears, a greater velocity than 750 turns a minute to light 16 candles with a luminous intensity of 50 to 55 Carcel burners. The exciter is, as in all cases, a continuous current machine, such as a Siemens or a Gramme.

Our readers know that we make a rule in to give opinions founded on facts only; we cannot say more, therefore, about the machine, however interesting it may be, and whatever may be the just authority of its inventor. We must wait for its application, which will shortly take place. The firm of Sautter Lemonnier

(who have kindly furnished the drawings for this article), in connection with the firm of Breguet, are actually constructing machines with 32 bobbins, and are preparing to make still larger ones.

It is worthy of note that it has been decided to follow the plan of making machines of large dimensions. In the place of accumulating a great array of complicated arrangements for transmission, by inconvenient bands and losing power enormously (employing a series of small machines, like playthings, in fact), it has been decided to construct apparatus capable of giving to each individual a result of some importance. We have preceded foreigners in this direction, but there is reason to believe that we shall not delay to draw them out, and the arrangement so practically ingenious due to M. Jablochkoff will not be a feeble attempt to attain this result.—*La Lumière Electrique.*

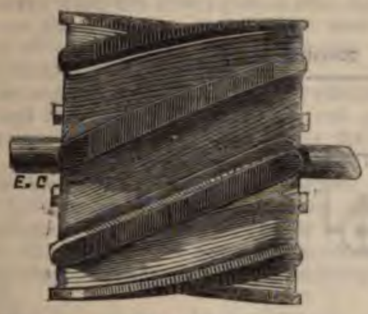


FIG. 1.

FIG. 2.

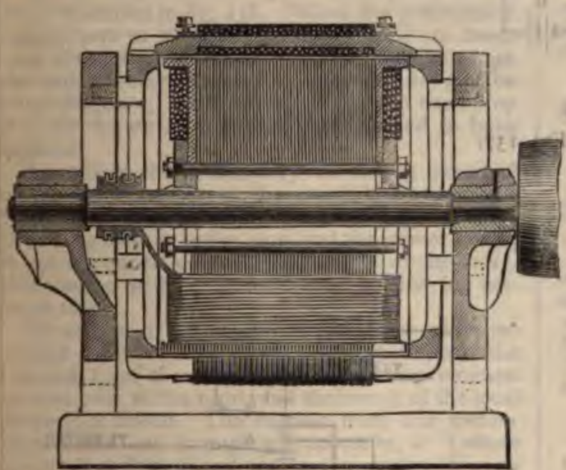


FIG. 3.

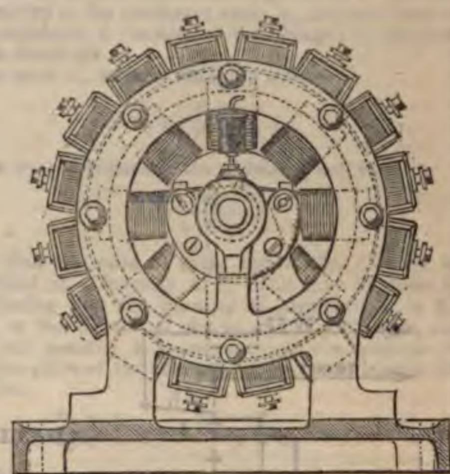


FIG. 4.

TELEGRAPHIC APPARATUS IN USE IN THE BRITISH POSTAL TELEGRAPH DEPARTMENT.

XXXIV. TIME SIGNALS.

IN order that the time signal arrangements may work with as little liability to derangement as possible, a definite and uniform system of supplying the signals to the various renters has been adopted. The general principles which have been kept in view in these arrangements are—

That on no account is the time signal to be sent to a renter by hand.

In all cases a switch is to be used to put the renter's wire and the London office through from the test box to the time relay. In the first or normal position of the switch the London wire is connected to the instrument which is normally worked on that wire. In the second position the London wire only is put through the time relay to receive the "preliminary" current, which shows that the time signal has been sent from London. When on the receipt of the preliminary current the switch is turned to its third position, then the renter's wire is put in communication with the tongue of the relay and a local battery, by which the signal is repeated to the renter. As the apparatus by which the cur-

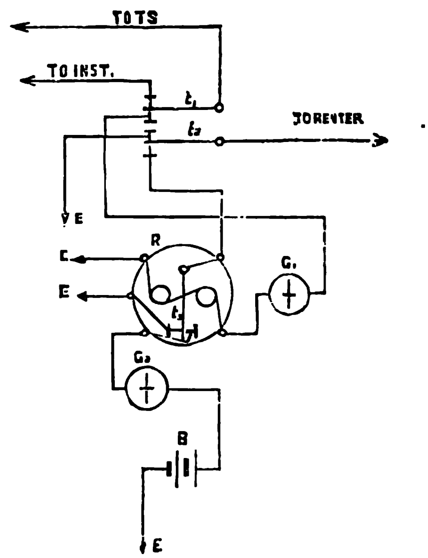


FIG. 137.

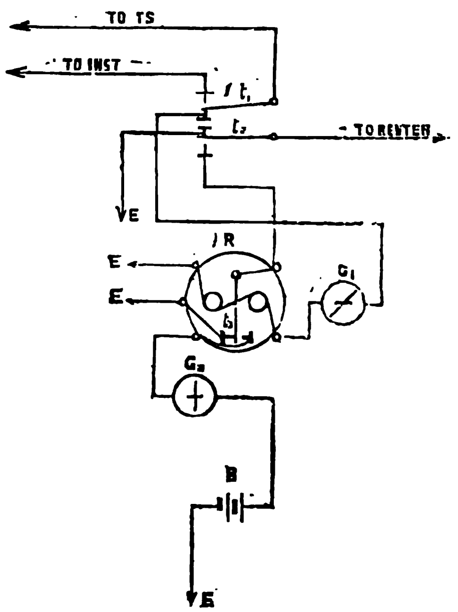


FIG. 138.

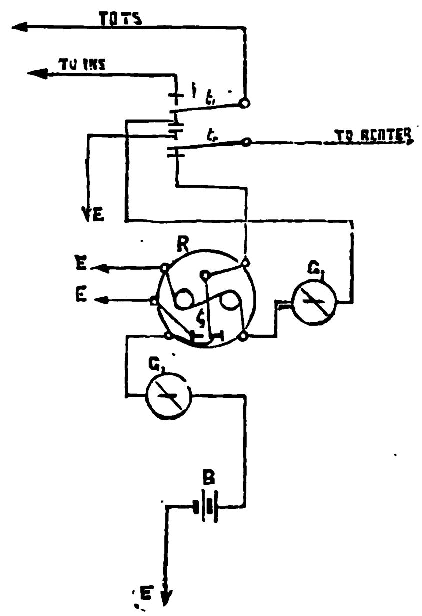


FIG. 139.

rent is received at the renter's differs according to the requirements of the latter, the preliminary current is not relayed on.

In all cases the time current is relayed to the renter, the back stop of the relay being connected to earth so that the renter's wire is always kept to earth except when the time signal is sent. Galvanometers are placed in the incoming as well as the outgoing circuits, so as to check both the receipt and distribution of the time signal.

The arrangement by which these principles are carried out is shown by figs. 137, 138, and 139.

Referring to fig. 137, which shows the switch bars, t_1, t, in their normal position, it will be seen that the line to TS (the London station) is connected through the bar, t_1, and its top stop, with the instrument by which the circuit is normally worked; the lower switch bar being in contact with its upper stop, the renter's wire is connected direct to earth.

In order to receive the preliminary current, which is sent a few minutes before the hour, the switch bars are turned by a hand switch to the position shown in fig. 138. When the preliminary current arrives it passes through t_1 and its lower stop, through galvanometer, G_1, and thence through the coils of relay, R, to earth. This current sets the relay tongue, t_3, hard over against its left-hand stop if it should not have previously happened to have been so.

As soon as the preliminary current is observed on the galvanometer, G_1, the switch bars are turned to their third position, as shown in fig. 139; bar t_2 is now against its lower stop, and the renter's wire is put in connection with the tongue of the relay, this tongue still being hard over against its left-hand stop.

Exactly at the hour the current from TS is reversed; this is indicated on galvanometer, G_1; the tongue, t_3, of the relay, R, is at the same moment moved over to the right, and the circuit of the local battery, B, closed. The current from this battery then passes out through galvanometer, G (whose needle is deflected) and out to the renter through the tongue, t_3, of the relay, and through the switch bar, t_2.

As soon as it is seen that the renter's current has gone out, the switch bars are turned back to their normal position, as in fig. 137.

Another principle is laid down that no renter is to be dependent upon the connections of the time receiving apparatus of any other renter. The current from the local battery, therefore, does not pass through a single wire with several renters on the circuit (except under exceptional circumstances), but splits between the different renters, each of the latter being on an independent wire connected to t_1. It is with this object that the tongue, t_1, is connected to earth, for in this case, all the wires being to earth, they cannot interfere with one another, nor can the renters use the wires for telegraphic intercommunication with one another.

In order that the local current may split equally between all the lines, the instruments of the renters are all required to be wound to a standard resistance.

Having now described the principal apparatus employed in carrying on the telegraph work of the British Postal Telegraph Department, these articles are concluded as a fortnightly series, but from time to time we shall publish descriptions of portions of the apparatus which have either not been touched upon, or which have recently undergone improvements.—[ED. TELEGRAPHIC JOURNAL.]

ON THE YIELD OF SECONDARY BATTERIES.

By M. E. REYNIER.

WORK performed by secondary batteries comprises two stages: the charge of the accumulator by the action of an exterior electric source, and its discharge in the circuit utilised. Each of these operations involves a loss. We shall seek to ascertain the expression of the yield. We have to consider: E_0, the initial electromotive force of the source; R_0, its resistance; E, the electromotive force of the secondary battery; R, its resistance; E_1, the difference of potential at the two extremities of the conductor used; R_1, the resistance of the conductor; t, the time of the charge; t_1, the time of the discharge.

The work T_0 spent in charging will be

$$(1) \qquad T_0 = E_0 \frac{E_0 - E}{R_0 + R} t.$$

The work T utilised in the resistance will be

$$(2) \qquad T = \frac{E_1^2}{R + R_1} t.$$

To find the ratio of these two works, t_1 must be expressed as a function of t. This may be done by considering that the quantity of electricity Q is the same in the circuits of charge and of discharge, and that this quantity is proportional to the products of the intensities of the currents by the times, whence the equation

$$\frac{E_0 - E}{R_0 + R} t = Q = \frac{E_1}{R + R_1} t_1.$$

Whence

$$(3) \qquad t_1 = \frac{t \dfrac{E_0 - E}{R_0 + R}}{\dfrac{E_1}{R + R_1}}.$$

On substituting for t_1 its value in the expression (2) this formula becomes

$$(4) \qquad T = \frac{\dfrac{E_1^2}{R + R_1} \dfrac{E_0 - E}{R_0 + R} t}{\dfrac{E_1}{R + R_1}} = E_1 \frac{E_0 - E}{R_0 + R} t.$$

Whence the yield

$$(5) \qquad \phi = \frac{T}{T_0} = \frac{E_1}{E_0}.$$

The yield is therefore expressed by the ratio between the potential at the two ends of the resistance utilised and the initial electromotive force of the source of electricity, and is independent of the resistances and the values of the times of charge and discharge.

I have supposed that the work to be produced was the heating of a resistance; if the current of discharge works in a circuit which is the seat of an electromotive force, *e.g.*, in an electric motor, the expression

of the yield will not be altered. But we must not take as the value of E_1 the difference of potential at the two extremities of the motor, for E_1 should express the inverse electromotive force of the motor at the origin of the induction.

We might arrive directly at the expression of the yield by putting

$$T_0 = Q\,E_0, \text{ and } T = Q\,E_1.$$

Whence

$$\phi = \frac{T}{T_0} = \frac{E_1}{E_0}. \tag{5}$$

But the foregoing developments show how the resistances are eliminated from the final expression; they give us the respective and relative values of the times of charge and discharge, and we show that if the resistances do not act upon the final yield they affect the time, and consequently the values of the works expended and recovered in a unity of time.

In practice the resistances of the circuits must be taken into consideration. On account of its very feeble interior resistance the secondary battery of Faure gives a yield of 80 per cent., the conditions of charge and discharge being favourable. For the small model of 7½ kilos. the constants of the Faure battery are

$$\begin{aligned} E &= 2{\cdot}15 \text{ volts.} \\ R &= 0{\cdot}006 \text{ ohm.} \\ E_0 &= E.\,1{\cdot}1 = 2{\cdot}36 \text{ volts.} \\ E_1 &= E.\,0{\cdot}9 = 1{\cdot}93 \quad ,, \\ R_0 &= R = 0{\cdot}006 \text{ ohm.} \\ R_1 &= R.\,9 = 0{\cdot}054 \text{ ohm.} \end{aligned}$$

The work expended in the charge is

$$\frac{E_0^2 - EE_0}{g\,(R_0 + R)} = 4{\cdot}21 \text{ kilos.}$$

per second and per element, an arrangement which enables the battery to be fully charged in a time much shorter than usual.

The work recovered per second and per element during the discharge will be

$$= \frac{E_1^2}{g\,(R + R_1} = 6{\cdot}3 \text{ kilos.}$$

Under these conditions the yield

$$= \frac{E_1}{E_0} = \frac{0{\cdot}9}{1{\cdot}1} = 81 \text{ per cent.}$$

Comptes Rendus.

Notes.

A DISCOVERY has been announced before the Cincinnati Scientific Society of a process for fusing and moulding iridium, which has hitherto been deemed impossible. A bar of this metal, which was used as a substitute for the negative carbon in an electric lamp, burned 60 hours without loss of weight or change of form.

M. TROUVÉ has made experiments with an English made tricycle, weighing about 55 kilogs. He fixed two of his electric motors, supplied with electricity by three secondary cells, such as he uses for his polyscopes, to each side of the machine, the motors being connected one to each crank. A friend rode the machine, which traversed the Rue de Valois, an asphalted street, at the speed of an ordinary cab. The experiment was continued for an hour. The total weight of the tricycle with M. Trouvé's friend on it was 160 kilogs., and the effective force produced by the two motors, seven kilogrammetres.

AN open competition for admission to the Post-Office (Male) School of Telegraphy, age 14 to 18, will be held in London on the 7th June next. Application must be made to the Secretary, Civil Service Commission, London, S.W.

THE ELECTRIC LIGHT IN AN ART GALLERY.—At a reception held at the Union League Club House in New York a few evenings ago the experiment of lighting a portion of the picture gallery with electric lights was tried with satisfactory results. One part of the gallery was lighted with gas and the other portion with Maxim's incandescent burners, supplied by the United States Electric Lighting Company, who also illuminated the street and avenue fronting the building with one of their powerful arc lights. It was considered doubtful if the commingling of the two lights—gas and electric—would be sufficiently harmonious to admit their use together without destroying the harmony of colour or richness of tint in some of the 90 beautiful paintings—valued in the aggregate at 265,000 dols.—which adorned the walls of the club house on this occasion. But the result has proved that the electric light is feasible for illuminating galleries of art, and in many respects that it is far better than gas for the purpose. The quality of the light approaches very closely to that of daylight, hence the artist's conception of colour is not distorted as by the yellow tint which gas produces. The picture appears to the observer as it did to the artist when it left his easel. The electric light takes up none of the oxygen of the room, the exhaustion of which in galleries where gas jets are used renders them uncomfortably warm, vitiating the atmosphere, and thus detracting from the pleasure of visiting such places at night. The result attending the exhibition the other evening, of using the electric light and gas light together, and then either separately, establishes the feasibility of using the electric light alone for exhibiting pictures to the best advantage or of blending the two and heightening the brilliancy. The Maxim incandescent burners were placed at intervals between the gas jets on the main pipe which extends around the room, so that the rays of light were projected from the same line, thus avoiding a cross light, which artists and exhibitors so much abhor.—*Scientific American.*

SWAN'S LIGHT IN GLASGOW.—The first exhibition of this light on a practical scale in Glasgow took place recently at the Sauchiehall Street offices of Messrs. D. and G. Graham, the licensees for Scotland, which were lighted up in a most brilliant fashion by 30 Swan lamps, arranged and adapted to suit every description of gas fixture—suspended, bracket, standard, universal joint, and otherwise. A pleasing variety was also attained by the use, in different situations, of plain, figured, opalesque, and tinted globes, and likewise by inclosing some of the lamps, Chinese-lantern fashion, in semi-transparent paper screens of novel and tasteful design. One lamp, which attracted particular attention, was shown glowing under water, with gold and silver fish circling round it, whilst another had its connecting wires concealed in a long flexible cord, so that it could be carried about without difficulty. Sir William Thomson, who was among the guests, made some remarks upon this system of incandescent lighting, calling attention to the fact that not only could all the lights in a room be simultaneously extinguished without putting out those in another, but that each individual lamp throughout the premises was under perfect control by means of a small plug-switch placed conveniently near

lso expressed his opinion that the problem of electric lighting was completely solved by the rD as exhibited that evening, and that its in households would, owing to the non-vitia- e atmosphere, be of immense sanitary benefit. wing evening the College of Science and Art Street was very effectively illuminated by 22 nps on the occasion of the annual distribution to the students, Sir William Thomson being air. The lighting of both places was planned ied out by Messrs. D. and G. Graham's , Mr. A. R. Bennett.

ESSION OF ELECTROSTATIC CONDENSATION AND ON IN UNDERGROUND TELEGRAPH WIRES.—By ain.—The author finds that if two long equi- r parallel lines are placed near each other, and e respectively traversed by the current of the he action of the current in one line disturbs the novement of the other. But if these two lines, f being equi-distant at all points, change their (e.g., from kilometre to kilometre) the induced become so feeble that a very sensitive electro- required to perceive them. The experiment still more conclusive if, instead of having two ines, we have 4, 6, 8, or 10 conductors. Whilst gth of 300 to 600 kilometres all telegraphic ion is affected, on applying the author's system y of the signals is surprisingly manifest. If in enfolding the conductors of one and the same und line in a protective coating of metal it is direct communication with the soil by a (gutta-percha, or Chatterton's composition), ensation diminishes to such an extent that the f electrostatic charge and discharge is com- one away with.—*Les Mondes.*

RIC LIGHT.—Lontin has exhibited in Paris an sun consisting of four voltaic arcs forming a circle. It is produced by means of four rods placed radially, but not touching each the centre. The two rods placed opposite to er were connected with the same pole of the light, so that an arc was formed from each both its neighbours. The four united form a circle, and yield a light of extraordinary —*Oesterr.-Ungarische Post.*

RIC LOCOMOTIVE LAMP. — In the night March 19th and 20th an experimental was made on the St. Michael-Leoben Austria, with a locomotive carrying an amp for the purpose of illuminating the line. tric machine was fixed over the locomotive d was set in action by a small steam-engine fixed on the boiler and deriving from it a supply . The lamp is fixed so as to be turned by the nd made to throw its light upon arches that traversed or upon any other desired point. lar experiments have failed hitherto owing to tive nature of the electric lamp, which could the shocks of the locomotive and thus a continuous light impossible. The present nstructed by Telegraph-assistant Sedlaczek, d the trial trip well. The light was steady, entire line could be distinguished for 400 to ds, and owing to the movability of the lamp k was distinctly visible for 200 yards even in through bridges. The colours of the signals distinguished at a long distance with great .

INATION OF THE ST. GOTHARD'S TUNNEL. ding to the *Tessiner Zeitung*, technologists have been for a long time engaged with the problem how the gigantic tunnel can be rationally lighted. Two systems have hitherto been suggested for practical application. The one proposes electric lights, placed at equal distances, and the number of which for an extent of 15 kilometres (the length of the tunnel) would be 1,200, requiring 40 electric batteries. The second system contemplates a kind of movable electric lighting. This demands the construction of a lighting locomotive to carry two electric batteries and four great luminous regulators, giving the light of about 12,000 ordinary lamps. The entire tunnel might be then lighted up by means of reflectors.—*Oesterr.-Ungar. Post.*

THE PRINCIPLE OF THE CONSERVATION OF ELECTRICITY OR THE SECOND PRINCIPLE OF THE THEORY OF ELECTRICAL PHENOMENA.—By M. G. Lippmann. —The quantity of matter and the quantity of energy are not the only magnitudes which remain invariable, the quantity of electricity has the same property. If we consider any phenomenon in its entirety we observe that the distribution of the electricity may change, but that the sum of the quantities of free electricity does not vary. If the electric charge undergoes at some points a positive variation it varies negatively at others, and the algebraic sum of all the simultaneous variations of charge is always null. The sum of the quantities of free electricity is therefore invariable since its total variation always $= 0$. This law, which I call the principle of the conservation of electricity, extends to all the phenomena hitherto studied and results from old experiments to which it is sufficient to refer. Thus, if a charge is divided between two bodies we know that the total charge remains the same before and after division. It is the same in the case of friction; it is known that the charges acquired by the bodies rubbed together have an algebraic sum $= 0$. It is the same in the case of electrification by the influence and the action of batteries. I will admit this fact as a principle which has been verified for all constant electric actions.

If we call two independent variables x and y, on which depends the quantity of electricity received by any body; x may be, for instance, the potential which this body acquires, and y its capacity, or a length, a pressure, or a temperature, of which this capacity is a function. Let $d\,m$ be the quantity of electricity received by the body, when x increases by $d\,x$ and y by $d\,y$. We may then put

$$d\,m = \mathrm{P}\,d\,x + \mathrm{Q}\,d\,y.$$

P and Q being two functions of x and y. I say that the principle of the conservation of electricity is expressed by the condition that $d\,m$ is an exact differential. Let us suppose any system whatever in which an electric phenomenon is produced, divided into two portions A and B. Let a and b be the variations of charge simultaneously experienced by these two portions; we have then, according to our principle, a and $b = 0$. When A passes through a complete cycle, its final state being identical with its initial, we have $a = 0$, and consequently $b = 0$. This latter equation may be written $\int d\,m = 0$. We know that for an integral $\int d\,m$ to be null for every complete cycle it is necessary for $d\,m$ to be an exact differential, which is expressed by the known condition of integrability.

$$(a)\ \frac{\delta\,\mathrm{P}}{\delta\,y} = \frac{\delta\,\mathrm{Q}}{\delta\,x}$$

This, therefore, is the general expression of the principle of the conservation of electricity.

The principle of the conservation of energy is expressed also by a condition of integrability. We

obtain thus two distinct equations, the simultaneous application of which to various known phenomena enables us to foresee the existence and the greatness of new phenomena.—*Comptes Rendus.*

A COMPANY has been formed in Spain, under the title "Sociedad Espanola de Electricidad," for the manufacture of Gramme and other machines used in obtaining the electric light, the production of electricity by means of great generators for distribution for the public illumination of large spaces, theatres, casinos, cafés, warehouses, manufactories, shops, &c.; for the propagation of the telephonic service by means of the installation of multiple lines connecting the houses of subscribers, and the distribution of motive power.—*Gaceta de la Industria.*

THE electric light is being introduced into Barcelona. Five electric lamps have been placed at the respective distances of 60, 100, 125, and 150 metres, four of them at the height of six metres, and one at ten metres. The electricity is produced by means of a dynamo-electric machine, moved by means of a steam-engine in the Calle del Cid.—*Gaceta de la Industria.*

ON THE INVERSE ELECTROMOTIVE FORCE OF THE ELECTRIC ARC.—M. J. Jamin.—M. Le Roux has recently communicated a simple process for demonstrating the existence of an inverse electromotive force in the voltaic arc. Edlund was the first to point out the existence of this inverse force, which has since been demonstrated by all experiments. It acts like the polarisation of the electrodes; it is developed as soon as the arc is ignited, increases rapidly to a fixed limit, and it opposes then, like the polarisation of the electrodes, a resistance to the passage of the current equal to 10—15 Bunsen elements. If we wish to light up an electric arc by means of a battery, we must first overcome this resistance by an equal number of elements, and then add about 25 others to obtain a sufficient arc. This is why at least 30 to 40 Bunsen elements are needed to maintain a regulator lighted. For the same reason it is so difficult to light up two or more arcs in one and the same continuous current, since for each arc it is necessary to overcome the same inverse force. It is intelligible, therefore, that every battery, every continuous-current machine, and every accumulator, like those of Planté or of Faure, has to struggle against this obstacle, and must have acquired a great tension before it can ignite even a single arc. The conditions are quite different with the magneto-electric machines with alternately contrary currents, as, for example, the "auto-exciter," of Gramme. In fact, the normal current, after it has passed in one direction, and the polarisation has become established, ceases, and is at once reproduced in the opposite direction—the direction of the counter-current, whose existence M. Le Roux has just demonstrated. Far from having to struggle with this inverse current, it profits by its existence, and the two electromotive forces re-enforce each other. Thus during each partial current there are two distinct periods. The first begins at the moment when the inversion is made, when the two actions are added together, and when the total current has its maximum intensity. Soon a polarisation contrary to the first is established, goes on increasing, destroys it, and there is then merely the normal current of the machine without polarisation. In the second period the inverse force is cut off from the normal current, the intensity is reduced to a difference, and decreases. If the inversions followed at long intervals the resistance to the current would have time to reach its maximum, and at the moment of each inversion there would be the same case as with the battery; but in these machines the inversion takes place at least 500 times per second. There are, therefore, at least 500 emissions of the current with an electromotive force equal to that of the machine, augmented by the inverse force created during the former emission. It is thus understood how it is possible to maintain several luminous arcs in one and the same circuit with a machine, and why it cannot be done with a battery or an accumulator. In the former case we profit by the inverse force at every interruption, whilst in the latter it must be overcome when permanent and at its maximum. It is probable that the time necessary for the inverse force to reach its maximum is very short, for the number of lamps which may be maintained in one and the same circuit increases rapidly with the speed. The latest improvements in the Gramme machine have brought this number to 15, or even 20 lamps, making 60 to 80 per machine, each equal to 25 Carcel lamps, or a total of 1,500 to 2,000 Carcels, at the expense of rather less than 20 horse-power. The existence of the electromotive forces is explained by Peltier's phenomenon. The current which passes from the positive point to the arc heats it considerably; then it continues and passes from the arc to the negative point, where there is cooling, or at least a feebler heating, and it is known that when the current ceases the difference of the temperature of the soldered connections sets up a counter-current. It is simply this difference of the temperature of the two points which determines the inverse force, but as this difference of temperature does not occur in case of alternating currents, this force cannot exist.—*Comptes Rendus.*

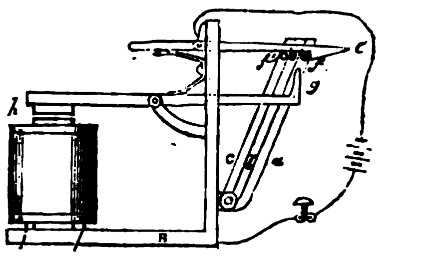
A PATENT (No. 240,578) for an improved telephone has recently been taken out in the United States by Professor Dolbear. The apparatus, which is shown by the figure, consists of a primary coil in circuit with bat-

tery, B, and transmitter, T, and a secondary coil with its enlarged terminal, *a*, mounted in case, *r s t*, and arranged near plate, *b*; plate, *b*, being also mounted in case, *r s t*, but not connected with the secondary coil.

AT the Royal Society, Edinburgh, April 17 (Sir Wm. Thomson, honorary vice-president, in the chair), Prof. Helmholtz, in an interesting communication on electrolytic conduction, stated that the experiments he was about to describe were a continuation of experiments he had formerly made in connection with certain objections that had been urged against Faraday's law of electrolysis. He had already shown that a feeble galvanic current could be passed through an electrolytic preparation of acidulated water, even though the electromotive force was not sufficient to decompose the water. The action of such a current would be, in the first place, to coat the electrodes, the one with hydrogen, the other with oxygen. The hydrogen, however, speedily combined with the free oxygen in the air and liquid to form water, while the oxygen on the positive electrode as speedily dissipated itself. In this way the polarisation in the electrolytic cell was kept down, so

that the original current was never wholly destroyed. In the later experiments Prof. Helmholtz had completely removed the air from the neighbourhood of the electrolyte. This was effected by an ingenious use of the property possessed by palladium of holding large quantities of hydrogen gas in its pores. With this specially-prepared cell he found that a feeble current passed through it fell down to zero in a very short time, the difference of potential due to the polarisation of the electrodes quite balancing the original electromotive force. On throwing off the battery the polarised electrolytic cell showed on a delicate galvanometer a reversed current, which rapidly fell to zero from an intensity equal to that of the original current before polarisation set in. Another result to which his researches had led him was, that there were no *chemical* forces acting between the molecules of an electrolyte other than those that existed in virtue of what might be called their electric charges—a result which cannot fail to have an important bearing upon the question of chemical constitution.—*Nature*.

AN ingenious form of electro-magnetic annunciator (U.S. patent No. 240,717) has been devised by Mr. George M. Hopkins, of Brooklyn. The pins, *f*, on the drops, *a b c*, that engage with the detent, *g*, and the catch, *c*, are all insulated except one, which therefore closes the



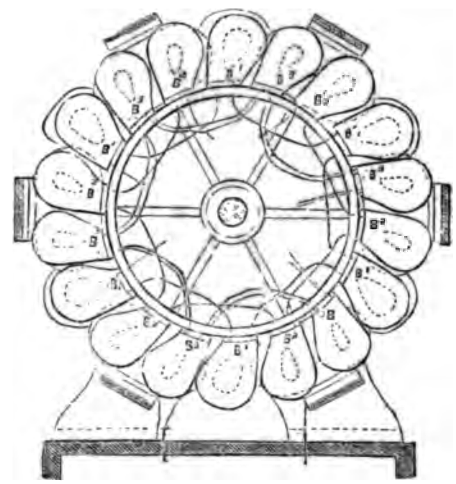
local circuit through the drop and detent when it comes in contact with the latter. The number of drops that have this circuit-closing pin on varies with the different instruments, so that a certain number of impulses may call a certain person.

AT a meeting of the West of Scotland Association of Gas Managers, held in Glasgow on the 6th inst., Mr. Carlow, the president, said that all over the country, in England as well as in Scotland, gas companies and corporations were now in a position of being able not only to reduce the price of gas, but to pay handsome dividends from the profits, and this had been done in the face of the formidable rival, as some supposed it to be—the electric light. While admitting that in recent years lighting by electricity had been improved to such an extent as to cause anxiety to those who do not pay very close attention to the subject, he held that the electric light had not taken the position which had been loudly claimed for it. One effect of the rivalry had been to cause gas engineers to devote special attention to the more perfect combustion of gas, and the result was the introduction of those fine burners which might be seen in almost every town shedding forth a brilliant light. Briefly touching on the proposal of Dr. Siemens to supply gas for heating purposes of a less pure character than that for lighting, he condemned it as being, from a practical point of view, unsatisfactory.

THE eminent engineer, M. Daubigny, to whom are due notable modifications and appreciable economies in the distribution of electromotive power for lighting by means of electric lamps, has solicited the municipality of Paris for permission to erect in the Place de la République, at a point to be fixed on, a great electric focus of 50 horse-power, the luminous power of which may be equal to 2,000 gas-burners. He proposes to demonstrate the economy of keeping the electromotive force of the luminous focus proportional to the extent to be lighted up, in place of graduating the light by means of glass globes more or less opaque. —*Gaceta de la Industria*.

THE Brush Electric Light has been fitted up in the retail warehouse of Messrs. Cooper & Co., Sauchiehall Street, Glasgow. This is the first application of the electric light to the illumination of stores in that city.

MULLER'S DYNAMO-ELECTRIC MACHINE (U.S. patent No. 241,054). In this machine, which is shown by the figure, the armature-coils are divided into series, each series having as many coils as there are field-magnets. One of the series, B[1], has its cores larger than the



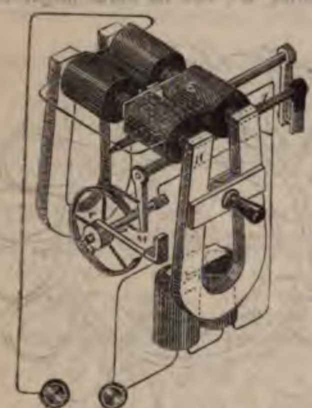
rest, and is used both to intensify the field-magnets and for external work, the remaining series, B[2], B[3], being used exclusively for external work. The cores of the armatures lap over the field-magnets about six-eighths of their width, so that they receive magnetism of both signs for a short interval, thereby avoiding extra currents and sparks.

MR. DUNCOMBE, secretary to the South Kensington Museum, in replying to queries put by the convener of the Greenock Harbour Trust as to the cost of the electric light, says:—"The system used is that of Brush. Sixteen lamps light a court previously lighted by gas, burning at the rate of 4,800 cubic feet per hour, and of the nominal illuminating power of 16 candles. The dimensions of the court are 138 feet by 115 feet, with an average height of about 42 feet. The hourly cost of the electric light, without allowing for wear and tear of plant or interest on capital, is about 5s. 10d. The machine cost £400. The 16 lamps, which are double lamps, together with the suspending apparatus, conducting wire, &c., cost £384. It is practically impossible to compare the illuminating power of the electric lamps with that of the gas, on account of the different nature of the lights. The engine indicates 20 horse-power when driving the machine. As the

result of six months' experience, it is found that the carbons cost 1s.; coal, 8d.; oil, cotton-waste, &c., 3d. per hour actual light for the 16 lamps. You will doubtless understand that it is difficult to fix precisely the cost of wages, as the men who look after the engine and the machine also do other work; but it is estimated at 1s. 11d. per hour, bringing up the total cost per hour to 3s. 10d."

IN consequence of the large increase of work in the Aberdeen telegraphic department it has been found necessary to increase the staff by eight. The staff, exclusive of messengers, will now consist of fifty-two telegraphists, of whom eleven are females.

HOVENBERGH'S PRINTING TELEGRAPH.—In this arrangement (U.S. patent No. 241,094) there is a peculiar unison mechanism in which the unison-stop is normally in the path of a stop on the type-wheel shaft, and locks the type-wheel if out of unison automatically at each revolution. If in unison a short



circuit is made at each revolution around the printing-magnet, whereby a strong current is passed through the type-wheel magnets, which releases the stop and permits the type-wheel to advance. The increase of current is due to the decrease in resistance offered by shunting the printing-magnet.

COLLEGE OF SCIENCE AND ARTS, GLASGOW.—The directors, with some of the most influential and worthy citizens of Glasgow, met the other evening in the large hall of the Mechanics' Institution (now called the "College of Science and Arts") to witness the distribution of prizes by Sir William Thomson, to the successful students of the past session. Sir William mentioned that it was at the Mechanics' Institute that he had gained his first impressions of those beautiful experiments in the elements of chemistry. He was grateful to the old Mechanics' Institution for what he had learned from it, at the same time he felt sure that it would prove worthy of the new and more dignified name. In handing the first senior prize for electricity and magnetism, to Mr. James Livingstone, telegraphist, Glasgow Post-Office, Sir William paid him the compliment that he had done a very good paper (he, Sir William, having set the greater part of the examination himself, and presented the prize). The other prizes and certificates for magnetism and electricity, junior section, were presented by David Rowan, Esq., the president of the Institution, and gained by (1) *T. B. Robinson*, (2) *Robert* Logan, and (3) certificate, *John Watson*.

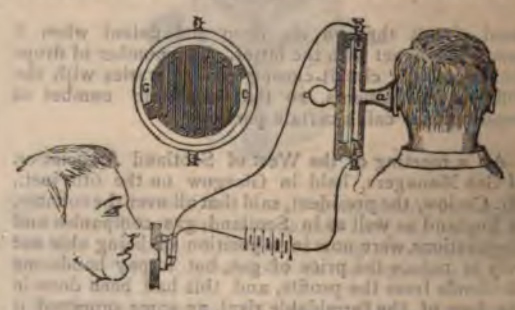
We understand that next session Mr. Andrew Jamieson, C.E., the principal, will start a class for telegraphy, telephony, and electric lighting, in connection with the City and Guilds examinations, in addition to the present lecture on magnetism and electricity, and we hope the telegraphists in the Glasgow district, as well as many others, will avail themselves of the rare opportunity thus offered to them, Mr. Jamieson having had considerable practical experience in the making, laying, and maintaining, of telegraph lines and cables, in different parts of the world.

Sir James Watson, preceptor, and Dr. F. L. Robertson, spoke at some considerable length on the prospects of the Institution, and all agreed that the grant of £600 a year, by Hutchison's Hospital, was one of the wisest things the directors could have done.

The hall was well lighted by twenty-two of Swan's electric lamps, the generator being an A Gramme machine, driven by a common sawmill engine. On inquiry as to how such an ordinary engine kept the light so steady, we found that the principal had the whole current under the control of a variable resistance coil with sliding contact, and besides he had a special telegraph wire connected with a bell laid on from the lecture hall table to the engine driver whereby by a previously arranged code of signals the desired steady speed was kept up. Messrs. D. and G. Graham, telephone engineers, Sauchiehall Street, Glasgow, kindly lent the generator and lamps and erected the wires under the direction of Mr. Jamieson, and Mr. Gray, joiner, Bath Street, supplied the necessary steam-power.

Altogether the meeting was most successful, and we believe there is a large field in Glasgow for such an Institution as the College of Science and Arts. We wish it every success.

GRAHAM BELL'S TELEPHONIC RECEIVER.—This instrument (U.S. patent No. 241,184), which is referred to in Professor Bell's paper, read before the National



Academy (published in our last issue), is a telephonic receiver having as a vibratory medium a deposited layer of lamp-black.

ELECTRIC LIGHTING IN THE CITY.—At a meeting of the Aldgate Ward Ratepayers' Association, on the evening of May 24th, Mr. George Rose Innes, jun., C.C., who was chairman of the streets committee of the Commission of Sewers at the time when their report recommending the experimental lighting of the City by electricity was adopted, brought forward the subject, and stated that the Commissioners of Sewers were giving the light a trial for twelve months, with a view of eliciting the opinion of the ratepayers as to whether the result would justify them in a continuation of the experiment. Mr. George Offor observed that they must not be discouraged if at first there were one or two failures. The ratepayers

ith much interest to the result of the working rush Company's light, as it was the most al. He had suggested that each side of the ould be lighted by a different wire in connec- a separate engine, to guard against a break- l he believed his suggestion was to be adopted. d of the twelve months he thought that the tion would be as to which was the system that e finally determined upon. Mr. Dresser C.E., observed that the Thames Embankment lighted with electricity for the past three d that the light had not failed for a single d as a proof of the advance which was being ted that, whereas the Jablochkoff Company first k the lighting, their contract was at the rate er electric candle per hour; after the first onths the price was reduced to 5d., six months s to 4½d., within three months after that to ist contract was 2½d., and at the last meeting etropolitan Board of Works they had offered the contract at 1½d., which the Board's elec- d reported to be the exact cost of lighting by honour was due to the Corporation and the itan Board of Works as being the pioneers of ment. Had they not come forward as they grand experiments could never have been ut, because private individuals could not have e heavy expense. The Brush Company's re now selling at a price equal to those of the l Gas Light Company. Mr. Offor asserted as hin his knowledge that within six months one npanies would be prepared to undertake the f private dwellings. Mr. Innes said that the ioners of Sewers, so far from being cast down le failures in the lighting which had occurred, rised that there had not happened something re serious. It must be remembered that Brush Company were charging the same for ng as the Gas Companies had charged under ntract, the light was eight times as brilliant.

ea of making hollow the various portions of nachines which are subject to being heated for se of allowing water to circulate is not new; of effecting the object has been patented in

by Messrs. W. E. Sawyer and E. R. Knowles, o. 241,242.) The armature, it will be seen, is of two concentric cylinders, the space be- e cylinders forming a passage for water, he armature is kept cool.

TRIC thunderstorm passed over Oldham on oon of the 22nd ultimo. What has been de- s a ball of fire struck the mill chimney of . Radcliffe & Sons, dislodging four large ones, which fell on the stables beneath, com- ishing in the roof and flooring. Fortunately s in the stables at the time, and the horses ork. The lightning conductor was wrenched stones for nearly an hour afterwards were

APHIC communication with Stornoway was n Monday last.

WE hear that proceedings are to be taken by the British Electric Light Company against certain dynamo machine manufacturers, and that they have already given instructions to their legal representatives. The question will probably turn upon the publication of the description of the Paccinotti ring prior to the date of the Gramme patent.

IT seems also possible that there will be legal difficulties eventually for the makers of the incandescent lamps. The similarity between the Swan, the Edison, the Maxim, and the Lane-Fox is so great, that having attended the exhibition of any of these systems, one may be said to have seen all. But perhaps there may be no law-suit, those interested may consider their various patents of *equal* value.

THE Swan Light has during the last week shone forth at Messrs. Edmundson's, at Westminster; the Maxim at Albany Street; and the Lane-Fox seems likely to burst forth from Hatton Garden, as well as from Heddon Street, Regent Street. Where is the Edison?

THE influence of atmospheric electricity on the vegetation of the vine has been studied near Palermo by M. Macagno (*Jour. de Agr. Prat.*) thus: Sixteen stocks were rendered more subject to the effects of the electric tension by means of a copper wire inserted vertically with platinum point in the upper end of the fruit branch, while another wire connected the bottom of the branch with the ground. This continued from April to September. An acceleration of vegetation was proved by the wood of these stocks containing less mineral matters and potash than that of the other stocks, while the contrary occurred in the leaves, and in these the potash was mostly in the bitartrate form. A much greater quantity of must was got from the grapes of those vines, and it had considerably more glucose and less acid.

ON the 9th of May M. Mercadier presented to the French Académie des Sciences a note on "The Reproduction of Speech by the aid of a Thermophone." The apparatus used, which is shown by the figure, consisted of a mouth-piece containing two diaphragms with an air space between. The diaphragm nearest to the mouth was composed of a thin sheet of mica, the other was also of mica but silvered. The rays from the

sun were reflected on the diaphragm and reflected through a lens on to a test-tube containing a blackened strip of mica; an india-rubber tube with an ear-piece was fitted over the end of the test-tube. Speech spoken in the mouth-piece was clearly reproduced from the blackened strip of mica.

THE ELECTRIC LIGHT IN AKRON, OHIO.—A novel, and thus far successful, experiment in electric lighting,

was inaugurated in Akron, Ohio, April 9. The town is lighted by two groups of lamps, one supported by an iron tower rising 208 feet above the street, the other by a wooden mast on the observatory of Buchtel College, about 40 feet higher than the tower lamps. Each group consists of four lamps of 4,000 candle-power each, or an aggregate light of 32,000 candle-power. The chief novelty of the system is the tall tower, made of boiler plate in 55 sections, each 50 inches in length. At the bottom the diameter of the tower is 3 feet; at the top 8 inches. The tower is steadied by six wrought iron guys reaching to the top. Over the lamps is a five-foot copper reflector, which serves also as a hood. Thirty feet from the street is a wrought iron balcony, to which the lamps are lowered for trimming. The entire electric circuit is 9,110 feet, the conducting wire being of copper. The total cost of setting up the system, including boilers, engines, &c., was 11,317 dols., and the cost of running the lights a year is estimated at 1,580 dols. The cost of the iron tower was 1,609 dols. The light promised from these two centres is to be equivalent to bright moonlight, over a circuit of half a mile radius from each group of lights, or two circular areas each one mile in diameter. It is thought that four more centres of illumination would supply the entire city. From 300 to 400 or more street gas lamps will be displaced by the electric lamps now in operation.—*Scientific American.*

Correspondence.

THE CONSERVATION OF ELECTRICITY.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—By the kind permission of Messrs. Macmillan & Co. I am allowed to quote the following paragraph from the Preface to my Elementary Lessons in Electricity and Magnetism, shortly to be published by them in their School Class-Books Series, and now in the press. The Preface is dated "March, 1881."

"The theory of electricity adopted throughout is that electricity, whatever its nature, is *one*, not *two*; that electricity, whatever it may prove to be, is not *matter*, and is not *energy*; that it resembles both matter and energy in one respect, however, in that it can neither be created nor destroyed. The doctrine of the *conservation of matter*, established a century ago by Lavoisier, teaches us that we can neither destroy nor create matter, though we can alter its distribution and its forms and combinations in innumerable ways. The doctrine of the *conservation of energy*, which has been built up by Helmholtz, Thomson, Joule, and Mayer during the last half-century, teaches us that we can neither create nor destroy energy, though we may change it from one form to another, causing it to appear as the energy of moving bodies, as the energy of heat, or as the static energy of a body which has been lifted against gravity or some other attracting force into a position where it can run down, and where it has the potentiality of doing work. So also the doctrine of the *conservation of electricity* which now is growing into shape,* but here first enunciated under this name, teaches us that we can neither create nor destroy electricity, though we may alter its distribution, may make *more* to appear at one place and *less* at another, may change it from the condition of rest to that of motion, or may cause it to spin round in whirlpools or vortices which themselves can attract or repel other vortices. According to this view all our electrical machines and batteries are merely instruments for altering the distribution of electricity by moving some of it from one place to another, or for causing electricity when heaped up in one place to do work in returning to its former level distribution. Throughout these lessons the attempt has been made to state the facts of the science in language consonant with this view, but rather to lead the young student to this as the result of his study than to insist upon it dogmatically at the outset."

The above paragraph is published at the present time because since the date when my manuscript was sent to the publishers a memoir has been presented to the Académie des Sciences, bearing the title, "Sur le principe de la conservation de l'électricité ou second principe de la théorie des phénomènes électriques." Of this memoir, which is by Mons. G. Lippmann, only a brief extract has as yet been published in the *Comptes Rendus* of the sitting of May 2nd, when it was read. In that short extract the general doctrine of the conservation of electricity is laid down with considerable clearness, and an elegant analytical expression of it is given in the briefest form. The author promising some examples of its application to the prediction of new and important phenomena. The publication of the complete memoir of M. Lippmann will no doubt be awaited with interest.

As my manuscript was placed in the hands of Messrs. Macmillan & Co. on the very day when the above extract was written, the phraseology used by M. Lippmann must have been adopted by him in entire independence of me. Some weeks must elapse before my Elementary Lessons will be in the hands of the public; I, therefore, wish to avoid meantime all chance of misunderstanding by taking the earliest opportunity, firstly, of making this acknowledgment which is due to M. Lippmann, and, secondly, of establishing my right to use the language of my Preface as to the explicit enunciation of *the doctrine of the conservation of electricity.*

SILVANUS P. THOMPSON.

University College, Bristol.
May 19th, 1881.

* This is undoubtedly the outcome of the ideas of Maxwell and of Faraday as to the nature of electricity. It has nowhere been more excellently or pithily put into shape than in a discourse delivered by Dr. Oliver J. Lodge before the London Institution, "On the Relation between Light and Electricity," December 10th, 1880.

THE ELECTRIC LIGHTING IN THE CITY.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—In my last letter to your admirable journal I noted the opinion I had formed on the electric lighting of the City, dwelling particularly on what I considered a *sine qua non* in street lighting—"simplicity." I little thought that so soon after the despatch of this letter the Brush would have broken down, and Siemens lowered his top-mast lights to a more reasonable altitude. In that letter I stated that to be successful in the lighting of road-ways, "simplicity" was, and ever must be, the desideratum; from what, therefore, has taken place, there can, I think, be little doubt regarding the truth of my remark. One of the savings in electric light is the dispensing with the services of lamp-lighters. It is calculated that in London alone, the loss to the gas companies, in having to commence street lighting long before darkness supervenes, is over £30,000 per annum; but, if electricity is to have lamp-lighting regulators to regulate the regulator of each individual lamp, it will not be long before the un-

doubted cheapness in the creation of the light is counterbalanced by the concomitant necessities of supervision. A well known outside City broker, whose wonderful success has proverbialised his name, and whose effusions in our daily press no doubt delight and charm his investors, in his endeavours to get clients to invest their money in the "Electric Light and Power Generator Company" writes: "Recent demonstrations prove that this Company's system divides the honours with the Brush Company." Of the Brush I shall say no more than that for the sake of electric lighting I trust that they are not to be brushed out for the City broker's pet company, with an admirable board and a most able council, I fail to see what they can do. For three years the system the E. L. & P. Co. have adopted endeavoured to light the Metropolitan Station at Aldersgate Street, but, with occasional flashings of superlative beauty, it has never succeeded for any time to give a good light, and although by the prospectus of the company, "intending subscribers" are invited to view this light at the above-named station, on going there, alas, *non est inventus*. The prospectus also mentions that their company is to light other stations on the same line of rail, also Queen Victoria Street and Southwark Bridge in the City. The failure of the Jablochkoff system, as named in my last letter, through an injunction in Chancery, to carry out their contract to light the City, brought the Lontin to the fore as a stop-gap, and but for the same legal bar Jablochkoff would now be lighting the stations of the Metropolitan Railway, save that one where for *longtemps* the brilliant Lontin has endeavoured to burst into refulgent flame.

Yours, obediently,

Junior Carlton Club. ELECTRON.

May 21st, 1881.

[We have received an answer to "Electron's" letter (which appeared in our issue of May 1st); but as it requires illustrating, we have been obliged to defer its publication until the next number.—ED. TEL. JOUR.]

Proceedings of Societies.

THE SOCIETY OF ARTS.

ON Wednesday, May 18th, 1881, F. J. BRAMWELL, V.P. Inst. C.E., F.R.S., Chairman of the Council, in the chair, a paper was read on "Electric Railways and Transmission of Power by Electricity," by ALEXANDER SIEMENS.

The researches of Sir William Thomson, Dr. Hopkinson, Professor Ayrton, and others, have proved that dynamo machines, if properly constructed, will render in the form of electrical work up to 90 per cent. of the energy expended upon them in the form of motive power. It may, therefore, be conceded that they are very efficient transformers, and that we can hardly hope to exceed the results already obtained by the best types of dynamo-electric machines. If, instead of using such a machine to generate electricity you send a current into it, the magnetic attraction created between the poles of the electro-magnets and the currents traversing the armature will cause the latter to rotate, and this motion can be communicated to other machinery in the usual ways. A pair of such machines, one for producing electricity and the second for re-transforming the current into motive power, can therefore be utilised for transmitting power to a distance. In order fully to understand the manner in which this transmission is effected, a large number of experiments were made at the works of Messrs. Siemens and Halske, in Berlin, by Dr. Frölich, and the results obtained were laid before the Royal Academy of Science in Berlin by Dr. Werner Siemens on the 18th November, 1880.

The principal conclusion arrived at was that the strength of the current in a given dynamo-electric machine depends only on the ratio of the number of revolutions per minute to the total resistance in circuit.

The idea of utilising these machines for transmission of power presented itself to Dr. Werner Siemens as long ago as 1867, when he discussed at the Paris Exhibition with other members of the jury the possibility of elevated electric railroads; but the dynamo machine was at that time not sufficiently developed to admit of a practical execution of the idea, and when the present more perfect forms were invented electric lighting monopolised for a time all the attention that was bestowed upon the practical application of the machines.

The transmission of power by electricity possesses a great advantage over the transmission of power by water or air, as the friction and leakage of the pipes, through which the latter have to be conducted, can never be determined in advance. It further has the advantages that the secondary machine works without producing any waste, which has to be disposed of, and that the small size and low weight of the machines obviates the necessity of heavy foundations for them.

In considering the possibility of employing the electric current to distribute power from a central station, the proportion of the power given out by the secondary machine to the power expended upon the primary machine, will not be of that deciding influence, as is generally supposed. Granted even that not more than 45 per cent. of the power expended can be reclaimed, it will still be possible to produce the power required at a cheaper rate than if each small place had its own steam-engine. For, at the central station, 1 horse-power could be produced by the large steam-engines with about 2¼ lbs. of coal, so that 1 horse-power given out by the secondary dynamo machine would be produced by burning 5 lbs. of coal per hour. There are few small steam-engines which will produce a horse-power with that expenditure of fuel, and if we take into account the trouble and risk connected with the running of steam-engines, it may be readily admitted that this loss is no real obstacle to the introduction of the electrical transmission of power. Of still less consequence will this loss be where waterfalls or other natural forces can be employed to drive the primary machines, in which case the power would cost practically nothing beyond the interest on the capital and the depreciation of the machines.

The electrical transmission of power, on account of the compactness of the machines, and the ease with which the conducting cables can be shifted, is particularly adapted to be used in cases where the driven machinery is erected only for temporary purposes. As an example, it may be mentioned that, when the cable ship *Faraday* was last at the works of Messrs. Siemens the machinery by which the cable is pulled on board was driven part of the time by a dynamo-electric machine.

In the summer of 1879, the model of an electric railway, which has since been exhibited at Düsseldorf and Brussels, and is at present working in the Crystal Palace, was shown at Berlin. The total length of this circular railway was 300 metres, and the gauge 1 metre. A dynamo machine, mounted on a carriage by itself, served as locomotive, and the passengers were conveyed in three carriages, each having seats for six persons. The current was conveyed from the primary machine to a rail laid between the rails on which the carriages run,

thence it was taken off by brushes fixed to the machine and sliding on the centre rail, it returned to the primary machine by the outer rails. When the carriages were prevented from moving the locomotive exerted a pull of about 4 cwt. (200 kilos.) on them; and when the train was in regular motion the pull varied between 1¼ cwt. and 1½ cwt. (70-80 kgr.), which represents, as the speed was about 10 feet (3 metres) per second, three horse-power.

The railway just opened for regular traffic at Berlin is a single line of 1 metre gauge, a little over 1½ English miles long. The permanent way has been constructed in exactly the same way as that of railways; wooden sleepers and steel rails are employed, the rails being connected, in addition to the usual fish plates, by short straps of iron, bent in the shape of a bridge, so as to admit the adjustment of the rails to different temperatures, and to reduce at the same time the electrical resistance. As the currents are low tension currents, it was not necessary to provide further insulation, and no difficulty is experienced in using one rail as the positive and the other as the negative conductor.

About a third of a mile from the Lichterfelde station the primary machine, with its steam-engine, is erected in the engine-house of the waterworks, and the current is conveyed from there to the rails by underground cables. The car is exactly similar to an ordinary tram-car, and is constructed to hold 20 persons besides the guard. It is symmetrical, and can move backward and forward, each end being provided with a starting lever for the guard, a brake handle, and a signal-bell. The dynamo machine is placed underneath the car, and transmits its movement to the wheels by means of spiral steel springs. The tires of the wheels are insulated from their axles, and are in electrical connection with brass rings, fastened on the axles, but insulated from them. Contact brushes press against these brass rings, and from them the current is conducted to the dynamo machine, and sets it in motion. If the railway continues to work in a satisfactory manner it is to be extended.

In the discussion which followed the reading of the paper, Professor AYRTON pointed out that for the transmission of power efficiently and economically the machines which ought to be used should be either dynamo-electric machines with separate exciters, or else magneto-electric machines.

THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.

AN ordinary general meeting of this Society was held on Thursday, May 12th, Prof. W. G. ADAMS, F.R.S., Vice-President, in the chair. The minutes of the last general meeting having been read and confirmed, and the list of new and proposed members read, a paper was read by Mr. W. H. PREECE, past president, on "Radiophony."

For 200 years unsuccessful attempts had been made to prove that bodies moved under the influence of light, and these failures were brought forward as arguments against the corpuscular theory of light. Prof. Bell was the first who had proved that light could produce mechanical effect; but these effects, although put forward as being due to light alone, had been shown by Dr. Tyndall to be in reality due to heat. A large number of workers had paid attention to the subject, and had given various names to the new branch of science. Prof. Bell, who at first had entitled his discovery "the production of sound by light," had more recently called it "the production of sound by radiant energy." Mercadier had read several papers on the subject entitled "Notes on Radiophony." Röntgen also had made researches in the subject, and had entitled his paper on the subject "Tones arising from the Intermittent Action of Light." Tyndall also had investigated and published the results of experiments he had made, the title of his paper being "Action of an Intermittent Beam of Radiant Heat upon Gaseous Matter." The author himself had brought before the Royal Society a paper which he had entitled "On the Conversion of Radiant Energy into Sonorous Vibrations."

Generally speaking, the subject might be called "Radiophony," which meant the conversion of radiant energy into sound. The term "sound" was given to a certain action which took place in the brain, that is, it was a sensation; externally, the action was the movement of sonorous vibrations.

Radiant energy was distinguished by the length of the waves which were produced. It had often been called "radiation," but the two were essentially different, the one being the producer and the other the thing produced. The old ideas of light and heat being two distinct actions was now abandoned, the two simply differed as regards their wave-lengths.

Radiophony had to deal with the impact of waves on substances. When the actions took place in the higher part of the spectrum, the apparatus producing sound might be called a "photophone," when in the lower, or red end, then the name "thermophone" was more appropriate.

Mr. Preece then showed the effect produced by an intermittent beam of light falling on an ebonite disc, fixed at the end of a hearing-tube, a sound being produced.

The question arose whether the effect was produced by the action of rays of high or low refrangibility, i.e., by light or radiant heat. Bell attributed the effect to light. Mercadier proved that the sound was loudest in the red part of the spectrum, thus showing that the effect was due to heat. Tyndall had also proved that the effect was due to heat.

If a thin sheet of ebonite was interposed in the path of the intermittent beam, then the sound was not diminished, although the light rays were cut off, thus again proving that heat caused the effect. Ebonite was remarkable in this respect that it allowed only the dark rays to pass through it. Captain Abney had succeeded in photographing through a sheet of ebonite.

Prof. Bell had accepted the theory that the effect was due to heat; he had considerably extended his experiments, and had shown that the sound produced varied with the colour of the substance acted upon, thus showing clearly that the radiant energy is converted into thermometric heat.

Were the sounds heard due to the expansion and contraction the result of heating? Heating takes time, and although Lord Rayleigh states that the action might be due to heating, yet experiments fail to prove this.

The experiments which the author had brought before the Royal Society, Prof. Bell did not consider were sufficient to prove the theory. Mr. Preece disagreed with this. Microphones failed to show that any vibration of the apparatus which confined the air took place, and other experiments also proved this, and that the effects were due to molecular pressure. The action might be explained by the Crookes radiometer. In the experiment with the ebonite disc, did the disc vibrate at all? This was answered by Mercadier's experiment with a cracked disc, which enabled sounds to be pro-

duced as equally well as with a sound disc; this was the case with discs of every kind of material, the *timbre* of the sounds not being varied by the material, a conclusive argument against Bell's theory.

If no disc were employed but a sheet of glass, then the sounds were good, but if the glass were slightly moved so as to leave the chamber into which the rays fell slightly open, then the sounds ceased because the air was no longer confined.

Mr. Preece next referred to the ingenious sonometer devised by Mr. Sumner Tainter for measuring the intensity of a sound.

Several experiments were next made to show the relative intensities of the sounds produced in the air-chamber of the photophonic tube; when the interior of this wooden chamber was left in its natural state, the intensity of the sounds heard were judged by Prof. Hughes to be equal to 5 divisions of his sonometer scale; when the interior was blackened by lamp-black, the intensity of the sounds was increased to 50. Mercadier and Sumner Tainter arrived at somewhat similar results by allowing the intermittent rays to fall on a blackened test-tube. This latter experiment Mr. Preece repeated with a large conical mouth-piece attached to the tube, the result being a sound which could be heard all over the lecture-room. The experiments of Bell and Tainter with flasks containing worsteds of various colours were then shown; the intensities of the sounds in the various cases being judged by Prof. Hughes to be as follows: black = 40, red = 20, yellow = 20, green = 13.

In the experiments made by Prof. Bell at Washington, where the sun's rays were very powerful, the effects were very marked; the best results being obtained with loose materials in the tubes.

Experiments were next shown in which the effects of an intermittent current passing through a spiral of platinum wire contained in a tube were made to produce distinctly audible sounds; when a Hunnings transmitter was used in the place of a wheel-break articulate speech could be transmitted.

Prof. Bell had recently discovered that lamp-black could be substituted in the place of selenium in his well-known photophone; these experiments had been repeated by Mr. Shelford Bidwell and Mr. Stroh without success, the effects obtained by Bell were probably due to the fact that the sun at Washington, where the experiments were made, was very powerful.

As regards the theory of the phenomena, Bell considers the latter to be due to the expansion and contraction of the air contained in the pores of the materials acted upon. Mr. Preece considered the phenomena to be due to a radiometer action, the rays falling on the blackened or coloured surfaces, and producing heat, which caused the particles of air to bound off with increased velocity; the effect would be the same in the cases where the rays fell upon gaseous vapours.

Mr. Preece then referred to the spectrophone of Prof. Bell. By this instrument a portion of the spectrum was explored which was hitherto unknown.

At the conclusion of the paper a vote of thanks was proposed by the president and carried unanimously.

The PRESIDENT then opened the discussion by suggesting that the term "Radiophony" might be considerably shortened.

Dr. J. MOSER said that with reference to the selenium experiment, he thought that the action, if it came to be examined carefully, would be found to be similar to that of the microphone, the microphonic action taking place between the selenium and its copper connections.

Mr. W. H. LEFEVRE gave the results of his experience as regards sounds heard when ballooning. He had noticed that when darkness intervened sounds became extinguished. De Fonvielle had noticed that sounds could be heard most clearly in a line with the setting sun. It was curious that the most penetrating sound was that of the barking of a dog.

Mr. R. E. CROMPTON asked whether Mr. Preece considered that radiant energy was communicated direct to the air in the chamber, or was it communicated by the medium of the walls of the chamber. With reference to the experiment with the microphone, he thought that however sensitive the latter might be, yet it would fail to detect vibrations which were sufficient to produce sounds but yet not nearly sufficient to affect the microphone.

Mr. PREECE in reply said that he had distinctly pointed out that a *surface* was necessary to produce the effects; he did not argue that the walls of the chamber did not vibrate at all under the influence of the light rays, but that the sounds heard were not due to such vibrations.

The meeting then adjourned.

PHYSICAL SOCIETY.—MAY 14th.

Professor FULLER in the Chair.

New members—Mr. D. J. BLAKELY and Mr. WALTER KILNER.

A COMMUNICATION was read from Prof. ROWLAND and Mr. E. H. NICHOLS, of Baltimore, U.S., on "Electric Absorption in Crystals." According to the theory of Clausius, Maxwell, and others, there should be no electric absorption in the case of perfectly homogeneous substances. Prof. Rowland tested this deduction in the case of glass, which is not quite homogeneous, quartz, and calcite. This was done by placing the material as the dielectric in a condenser formed of two amalgamated copper plates. The condenser was charged by six Leyden jars, and the absorption measured by a quadrant electrometer. The results were that quartz had about $\frac{1}{9}$th the absorptive power of glass, and calcite none at all.

Dr. HOPKINSON said that the *kind* of glass was important, and threw doubts on the theory that the absorption was due to heterogeneity. Paraffin wax had little absorptive power and yet was very heterogeneous.

Professors PERRY and AYRTON thought that two non-homogeneous substances in combination might have a residual charge.

Mr. LEWIS WRIGHT suggested that the optical character of crystals should be considered in these experiments, which might be extended to other crystals. Calcite is uniaxial.

Prof. MINCHIN, of Cooper's Hill Engineering College, described his new absolute sine electrometer. This consists of two metal plates, in one of which is an aperture nearly closed by a metal trap-door, suspended from the plate by two fine platinum wires and resting against fine stops when the plates are hung vertically. These plates are connected to the poles of the cell to be measured, and tilted out of the vertical till the attraction of the whole plate on the suspended trap or shutter is just balanced by the weight of the latter. The electromotive force is then proportional to the sine of the angle of displacement.

Dr. LODGE remarked that the apparatus combined sensitiveness with practicability. The E. M. F. of a single cell could be measured by it, whereas Thomson's absolute electrometer could only give the total of a number of cells.

Prof. AYRTON stated that he and Prof. PERRY hoped

to modify the instrument in the direction of sensitiveness by adding another plate and giving it a high charge.

Dr. COFFIN suggested reversing the process of taking an observation.

Prof. FOSTER read a paper by Dr. J. E. MILLS on the ascent of hollow glass balls through liquids. A glass ball of a pear shape rises through a liquid with a sensibly uniform velocity, which varies with the liquid. The time of ascent is proportional to the square of the diameter of the vessel, and depends of course on the specific gravity of the contents of the bulb. Dr. Mills measures the density of gases and liquids in this manner.

Prof. PERRY thought that the bulb should be of a shape having no re-entrant angles.

New Patents—1881.

2013. "Apparatus for generating and conveying electricity." A. MASSON. Dated May 9.

2038. "Electric lighting apparatus." H. J. HADDAN. (Communicated by R. J. Gulcher.) Dated May 10.

2041. "Apparatus for controlling and localising electric-currents for the transmission of electric signals and messages." L. M. DE BEJAR Y. O'LAWLOR. Dated May 10.

2057. "An improved magnetic comb." J. M. RICHARDS. (Communicated by P. H. Drake.) Dated May 11.

2079. "Improvements in the construction of electric lamps, and in sealing electrical conductors into air-tight receivers." C. H. GIMINGHAM. Dated May 12.

2175. "An improved method of regenerating or restoring the energy of electric batteries." W. R. LAKE. (Communicated by L. Maiche.) Dated May 18.

2198. "Electric lamps." C. D. ABEL. (Communicated by W. Tschikoleff and H. Kleiber.) Dated May 19.

2212. "Dynamo-electric machines." C. A. BARLOW. (Communicated by A. de Meritens.) Dated May 20.

2215. "Couplings for electrical conductors." P. R. ALLEN. Dated May 20.

2217. "Electrical cables or conductors for telegraphic and similar purposes." W. R. LAKE. (Communicated by P. B. Delany.) Dated May 20. *Complete.*

2256. "Supporting structures for electric wires or conductors and lighting apparatus." W. R. LAKE. (Communicated by W. C. Allison.) Dated May 24. *Complete.*

2263. "Construction of apparatus for effecting electrical measurements." J. C. CUFF. Dated May 24.

2264. "Cables or conductors for electrical circuits." W. C. BARNEY. Dated May 24.

2265. "Telephone transmitting apparatus." J. T. GENT and H. G. ELLERY. Dated May 24.

2272. "Secondary batteries or apparatus for storing or conserving electricity." J. W. SWAN.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1880.

1705. "Liquid compound for the electro-deposition of aluminium." LUIS ALWYN DAVIES. Dated April 26. 2d. Relates to an improved bath or liquid compound for the electro-deposition of aluminium. To common alum of commerce is added ammonia, the precipitate formed being alumina. This precipitate is thrown on a filter paper, washed, and redissolved in a hot solution of neutral tartate of potash. This solution is evaporated nearly to dryness and redissolved in sulphuric acid. This salt is then crystallised out of the solution, and the crystals dissolved in water. This solution forms the bath, which is then ready to be used for the deposition of aluminium. As an anode either a plate of aluminium or a bag of alumina may be used. If the latter a plate of platinum or carbon is used to complete the circuit. (*Provisional only.*)

1828. "Clocks, &c." W. R. LAKE. (A communication from abroad by the Compagnie Générale des Horloges Pneumatiques, of Paris, France.) Dated May 4. 8d. Relates chiefly to clocks worked by pneumatic action. Electricity is employed to control the air pressure. The controlling apparatus has a glass cylinder, into which is inserted the lower extremity of a tube of the same material. The said cylinder contains mercury, and is in communication with the air in the circuit through a cock and tube. One of the poles of a battery is connected with the cylinder by a wire immersed in the mercury contained in the said cylinder. When the circuit is in communication with the distributing reservoir, the pressure in the said reservoir is communicated to the mercury in the regulator, and the said mercury rises in the tube; but when the circuit is in communication with the escape or discharge pipes, the mercury in the tube descends into the cylinder. With this arrangement, should the pressure in the circuit be too high, the mercury would continue to rise in the tube, and would come in contact with a pointed piece of platinum permanently connected with an alarm bell in the circuit of the battery. If, however, the clock circuit becomes interrupted or broken through any cause whatsoever, the mercury in the tube would continue to fall. The cylinder would rapidly fill, and the mercury it contains would rise and come in contact with another pointed piece of platinum in communication, as in the former case, with the alarm bell. The glass tube is closed at its upper extremity by a cap constructed as follows:—The platinum wire passes through its centre, in which is adapted a stuffing-box. In the said cap are two orifices; in the first orifice is inserted a screw pin for the purpose of partially or entirely closing the orifice, and allowing the atmospheric air to enter with more or less freedom, thus causing the mercury to fall more or less rapidly. The flow can by these means be regulated so as to rise and fall once each minute, the rise coinciding with the pressure in the circuit pipes, and the fall with the escape or exhaust. In the second orifice is a spring valve, allowing the air in the tube to escape quickly whilst the mercury rises, that is to say, whilst there is pressure in the circuit pipes of the clocks. The play of the said spring valve is regulated by a screw. Should the circuit be interrupted or broken the mercury in the tube will fall continuously, as the external air would have free ingress into the said tube through the orifice, and the mercury would tend to descend to the same level as that in the cylinder.

1942. "Signalling apparatus." W. P. THOMPSON. (A communication from abroad by M. Jacques Victor Michel Bartelous, of Brussels.) Dated May 12. 1s. This invention is designed to enable one to place on one wire an indeterminate number of instruments, each capable of communicating to a receiving bureau its own special signal, and so that the office can discover at once which apparatus is at work. The fire alarm wire is in communication at one end with the earth, at the other with a terminal of the instrument conducting the current to an electro-magnet. The electro-magnet

actuated by the current pulls down an armature on a lever which releases a weighted needle with a disc. This at once shows if the apparatus is working and acts as a tell-tale, as it cannot be replaced without unlocking the glass case in which it is inclosed. The movement of the lever breaks the communication with the needle and suppresses the "householder's" current; at the same time a large wheel or disc is freed from the catch at the end of the armature lever, and is set in motion by clockwork. On the fore-part of the armature lever is a block resting, when not working, on two conducting pieces. One of these communicates with the receiving bureau, the battery, and the earth, the other with the system or line wire. The raising of the block suppresses communication with the line wire and bureau. The large wheel or disc has metal contacts, which by rotating gives dot and dash signals in the usual manner.

2229. "Apparatus for lighting gas, &c." CHARLES LEIGH CLARKE and JOHN LEIGH. Dated June 1. 6d.

FIG. 1.

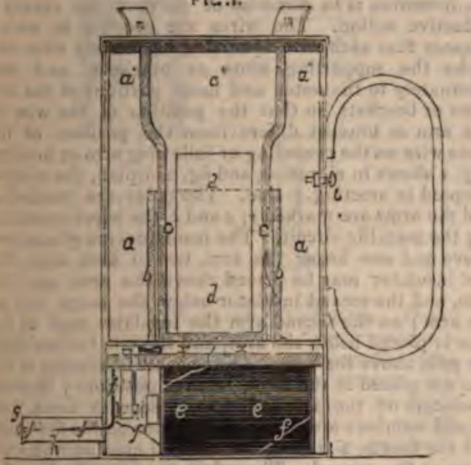


FIG. 2.

The principal object of this invention is to construct a convenient, durable, and portable form of hand lamp or apparatus for lighting gas by means of electric sparks or platinum wire heated by the electric current. Fig. 1 in the annexed drawings is a vertical section and fig. 2 a sectional plan view of the under part of the apparatus, showing one modification of battery which it is proposed to employ. This battery is formed of an outer cell, *a a*, containing a zinc cylinder, *b b*, and exciting fluid; inside this is placed a porous cell, *c c*, containing a carbon block or rod, *d d*, or other suitable material, together with the necessary fluid, both cells having convenient compartments or spaces, $a^{\times}$ and $c^{\times}$, left to allow of the exciting fluids being separated from the positive and negative elements of the battery when not in use. The upper portion, $c^{\times}$, of the porous cell, *c*, *c*, has its compartment either saturated with some suitable non-conducting substance or is enamelled or glazed in order to do away entirely with "endosement" when the cell is out of action, and so prolong the durability of the exciting fluids. If a condenser is used with the coil it is placed by preference round the external surface of the outer cell, *a a* (or beneath the same, as shown at *x*, fig. 1), to economise space, the induction coil, *e e*, being placed with its adjuncts beneath it. From the terminals of the induction coil, two wires, f, f^{1}, are carried to two points, f^{11}, f^{111} (respectively), in a suitable short tube, *g*, *g*, and insulated, these two points being separated by a sufficient space, across which (when the apparatus is working) the electric spark or sparks pass. The tube which carries the ends of the wires from the induction coil (or in the other case the platinum wire) has a guard, *h*, *h*, of wire gauze attached to it, so that the gas burner cannot be brought into contact with them and displace or injure them. It is sufficient to connect the wire, *f*, with any part of the metallic casing of the apparatus for the current of electricity to pass from the point, f^{11}, and complete the circuit. The apparatus has a suitable "commutator," *i*, *i*, provided, which breaks the circuit, excepting when pressed down by the thumb or finger, so that the whole apparatus is out of action in its normal state. When the "commutator," *i*, *i*, is pressed the circuit is then completed, and a spark (or sparks) will pass from the end of one wire to the other wire, or the fine platinum wire is heated, and either may be used for lighting the gas.

2312. "Diving bells, &c." W. R. LAKE. (A communication from abroad by Charles Frederick Pike, of Philadelphia.) Dated June 8. 10d. Relates generally to apparatus for submarine or subaqueous operations, parts of which apparatus are applicable for other purposes. The electrical part relates to the employment in connection with mechanism for controlling the hydraulic or atmospheric pressure of electrical mechanism for actuating the controlling mechanism, the construction being such that a workman within the bell by means of the electrical mechanism may readily actuate the controlling mechanism, and thus cause the submerged grappling tongs or other tools to be operated in accordance with his wishes without the intervention of other persons.

2445. "Floats and apparatus for indicating the water level in steam boilers." FLORENT LADRY. Dated June 16. 6d. Relates to apparatus for indicating the water level in steam boilers, and consists of an improved float which actuates automatically certain mechanism serving to indicate the height of the water level, and capable of giving an alarm by sounding a whistle, and by ringing electric bells, the latter being situate at any required distance from the boiler.

2665. "Protective and insulating casings for underground telegraphic wires, &c." W. R. LAKE. (A communication from abroad by Restore B. Lamb, of Camden, New Jersey, United States of America.) Dated December 29. 6d. Relates to an improved protective and insulating casing or covering for underground telegraphic, telephonic, or other wires. The said casing or covering is formed of a succession of blocks of terra cotta or other material, each having one or more longitudinally extending passages or channels, the walls whereof are lined with india-rubber or equivalent material, whereby the wires may be reliably conducted from place to place, properly separated, conveniently introduced and removed, and effectively insulated or protected from the action of the earth, frost, water, or the like. Fig. 1 is an end view of a

casing or covering constructed according to this invention, and fig. 2 is a longitudinal section of the same on line, *x x*, fig. 1. Fig. 3 is a side elevation thereof drawn to a reduced scale, showing a testing station. A represents a section or portion of the casing, conduit, or covering, which is formed of a piece or block of terra cotta or other suitable material. B represents a series of longitudinally extending passages or channels, which are formed in the said block and are lined with soft india-rubber or india-rubber tubing, C. In practice the sections or blocks, A, are laid in a suitable trench in the ground and united one to another or placed close to each other, the lining being drawn or pushed through the sections as the line is being built up, and the wires properly introduced through the tubular lining, the lengths of the said wires and lining being connected or united as the line is continued or extended. Suitable offsets or branches and testing stations are provided,

FIG. 1

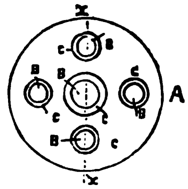


FIG. 2.

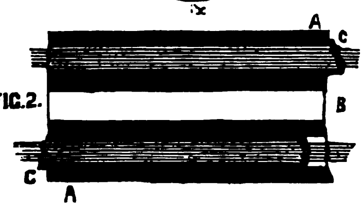
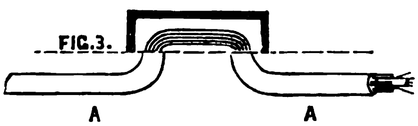


FIG. 3.



one form of the latter being shown in fig. 3. The passages or channels, B, formed in the blocks, A, are employed for wires of different lines or directions, and a sufficient number of these channels is provided to serve as a reserve to meet the demands of the extension of the line and other requirements. The india-rubber lining, owing to its tubular form, is sustained at all points within the passage or channel in which it is placed, and in a measure clings to the said passage and will not collapse or break down on the wires. It is furthermore protected from contact with and the action of the earth by the material of the surrounding block, and owing to the nature of the lining, water and moisture are prevented from reaching the wires, the latter being thus shielded and preserved. Furthermore, if insulating fluid is required for the wires, the lining forms an advantageous conduit, as it is continuous and of a non-absorbent nature, and as the lining is tubular it retains its shape and location in the passages or channels as above stated. The wires may be readily drawn through the tubular lining and removed therefrom when required. The lining also may be removed when necessary and replaced if found defective; and should a line be abandoned the lining may be withdrawn intact and the blocks afterwards dug out if required for further service. While the lining may be formed of other material, the equivalent of india-rubber, the latter is desirable, as by its elasticity it may be made to snugly and tightly fit the passages or channels, B, without injury, and prior to its application to the blocks, may be coiled or bundled and transported without affecting its tubular form.

2690. "Telegraphic wires, &c." CHARLES MOSELEY, WILLIAM FEREDAY BOTTOMLEY, and WILLIAM EDWIN HEYS. Dated December 31. 6d. The object of the invention is to diminish or prevent the results of inductive action. The wires are erected in such a manner that each wire is carried alternately over and under the supporting arms or brackets, and also alternately to the outer and inner portions of the said arms or brackets, so that the position of the wire on one arm or bracket differs from the position of the same wire on the preceding or following arm or bracket. Fig. 1 shows in elevation, and fig. 2 in plan, the method adopted in erecting a line. The poles are marked *x*, and the arms are marked *y*; *a* and *b*, the wires constituting the metallic circuit. The insulators are placed one above and one below the arm, two to each arm; the first insulator may be placed above the arm near the pole, and the second insulator below the outer end of the arm; on the second arm the insulator near to the pole is placed below the arm, and the one further from the pole above the arm. All the other insulators in the line are placed in the same relative positions; thus the insulators on the third, fifth, and seventh arms, and all odd numbers are the same as those on the first arm, and the fourth, sixth, eighth, and all even numbers the same as the second. The wires are attached to the insulators in the ordinary manner, but, instead of proceeding in a straight line as usual, they are laid around each other thus:—The first or leading wire, *a*, is secured to the insulator, *c*, on the first arm, to the insulator, *e*, on the second arm, to *g* on the third arm, to *i* on the fourth arm, and to *k* on the fifth arm, and so on. The return wire, *b*, is attached to the insulator, *d*, on the first arm, to *f* on the second arm, to *h* on third arm, to *j* on the fourth arm, and to *l* on the fifth arm. On this arm the two wires occupy the same relative positions as on the first arm, having, however, made a complete turn round each other between the first and fifth arms.

FIG. 1.

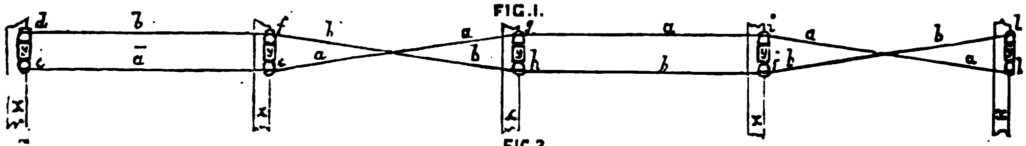
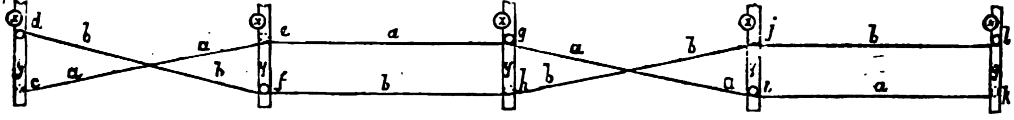
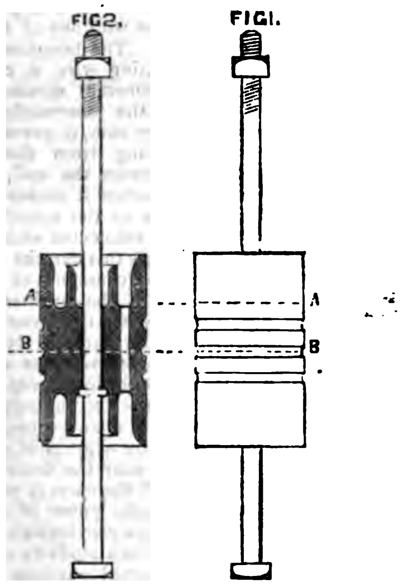


FIG. 2.



"Telephonic apparatus." H. H. LAKE. (A ation from abroad by Louis Maiche, of Paris, Dated August 7. 6d. Relates to the described on page 203 of this Journal.

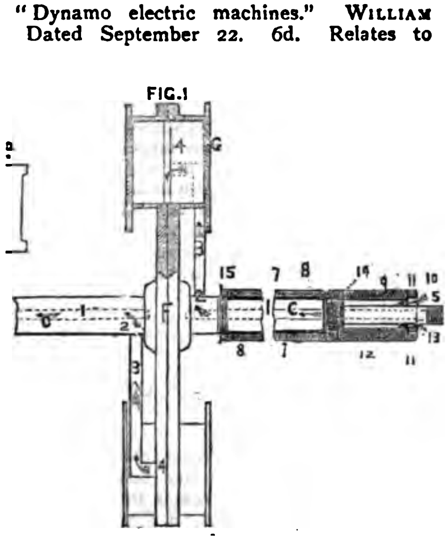
'Shackle and terminal insulators for tele-



res." JOHN WILLIAM FLETCHER. Dated . 6d. Has for its object improvements in and terminal insulators for telegraph wires. an elevation of one of the insulators; it is ne piece; the bolt on which the insulator is also shown; fig. 2 is a longitudinal section ne insulator. The iron bolt is fixed vertically wo arms on the pole.

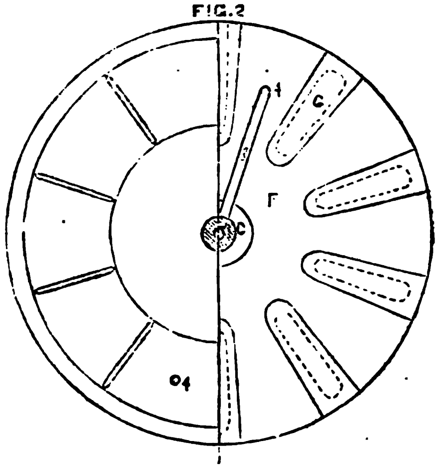
" Dynamo electric machines." WILLIAM Dated September 22. 6d. Relates to

FIG.1



nents in the dynamo-electric machines, de- n the number of THE TELEGRAPHIC JOURNAL for April 1, 1880, the object being to provide an improved body for the revolving armature so as to provide for the cooling of the same and its magnets, and thereby insure the coolness of the magnets of the whole machine, and to provide a commutator of improved construction for facility of connection and avoiding the secretion of metallic dust in the section of the commutator under the brushes, so avoiding short circuit between the sections, and also provide for the connecting up of the wires of the stationary or field magnets. Fig. 1 is a view partially in section of the revolving

FIG.2

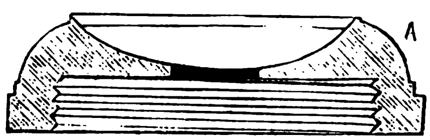


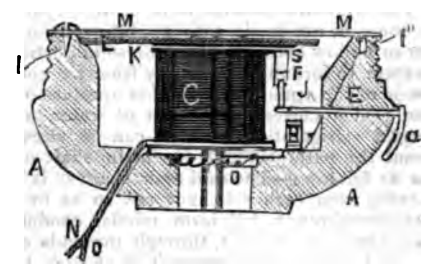
armature and main shaft of a dynamo-electric machine, showing the hollow and passages for the cooling of the armature of such machines, and also the fitting of the commutator. Fig. 1ª represents the plate to be placed, if desired, in recess of armature magnets. Fig. 2 is side view partially in section of the improved armature, fig. 1. The armature cylinder, boss, or disc, F, and the magnet cores, G, are made with a continuous internal chamber or hollow extending into the solid portions of the armature to form a passage way from an aperture on one side of the armature to another aperture on the other, so that a current or stream of water, air, or other liquid refrigerating medium can be circulated throughout the parts through the main shaft of the machine as follows:—The said main shaft, C, is bored out centrally from each side, but not so as to communicate therethrough, but form tubular conduits, 1, shown in dotted lines, fig. 1, through the ends of the shaft, C, and at the inner extremities of such boring and transversely of the shaft secondary borings, 2, are made so far through the shaft as to meet the central borings, 1, at right angles, into which secondary borings, 2, short lengths of tube, 3, are fitted to connect with the inlets or outlets, 4, of the armature circulating chamber. The outer ends of the shaft are furnished with thread, 5, for reception of the cap of stuffing-box, through the centre of which cap is passed the end of a conduit tube corresponding with the central borings of the shaft, said conduit tubes being carried in end bearings or supports from the framing or bed plate of the machine. Thus a head or supply of water, air, or fluid cooling medium can be supplied to one of the conduit tubes at one end of the shaft of the machine, and flow through the central boring of the shaft to the aperture on one side of the armature chamber, out by the opposite aperture to the other central boring of the shaft, and thence be led off by the conduit tube passing through

the stuffing-box at the other end of the shaft in direction of the arrows, fig. 1, whereby a continual flow can be kept up through the armature during its revolution to insure the effectual cooling thereof. The magnet cores, G, are preferably cast with the body, F, of the armature cylinder, boss, or disc, or may be bolted thereon, and said body is in two halves, with the corresponding portions of the chamber or passage provided therein, as shown by the drawings, and when put together may be fitted with a dividing plate or plates, fig. 1A, through which is or are made a perforation at one part to complete the continuous chamber for the circulation therethrough of the cooling medium, and the divided portions of the armature are bolted together, or may be brazed and bolted.

3925. "Lightning conductors." SAMUEL VYLE. Dated March 28. 6d. Relates to the construction of lightning conductors or protectors in such a manner as to allow of their condition, with respect to effectiveness of action or defects, being readily ascertained.

4039. "Telephones." JAMES GRIEVE LORRAIN. (A communication from abroad by Gustave Trouve, of Paris.) Dated April 5. 6d. Relates to a system of signalling apparatus applicable to telephones of every description. According to the invention the signal is produced by means of vibrations communicated to the diaphragm, the latter having imparted to it a tremulous motion under the influence of a current which is caused to pass in the coil of the telephone. The figure is a transverse section of the apparatus with the mouth-piece of the telephone detached. M is the vibrating plate or diaphragm of a telephone of ordinary construction, having a case, A, containing





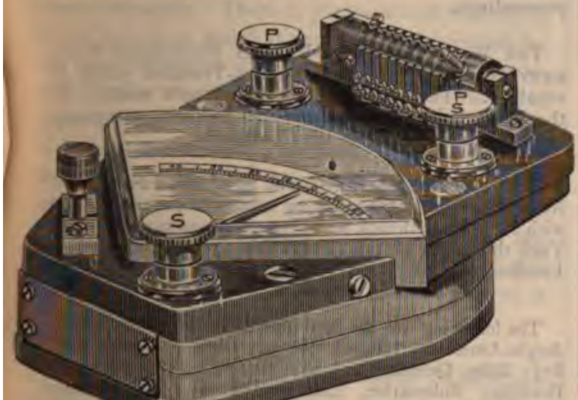
the usual magnet and coil, C. Through one side of the case, A, passes a spindle, E, which is provided at one extremity with a needle or pointer, *a*, and at the other extremity with two cams, F and G, arranged at right angles to each other. This spindle is maintained constantly in communication with the line by means of a spring, J, and the diaphragm is electrically connected with a spring, H, screwed to the bottom of the recess provided in the case, A, for the reception of the coil, C. The spindle, E, acts as a commutator, and also enables the tremulous motion to be imparted to the diaphragm, M, as hereinafter described. When the apparatus is in readiness for speaking, the pointer, *a*, is turned round. This action has the effect of rotating the spindle, E, so as to cause the cam, G, to press upon the spring, H. A small portion of the under side of the diaphragm, M, is scoured or scraped, and bears against three contact poi and I¹¹, of copper set in the wooden case, point, I, is connected with the wire passing coil, C; the point, I¹, is perforated for the of a pin fixed to the diaphragm; and th I¹¹, is in communication with the spring, telephone is provided with a conducting wire, is in constant communication with the pc battery at one end, and directly with one of t of the coil at the other end. The telephon provided with another conducting wire, O, c with the line wire, and in constant comm with the spindle, E, through the interventio spring, J, consequently when the cam, G, press spring, H, the current coming from the through the conductor, N, passes the coil, through the diaphragm, M, whence it passes the spring, H, and the cam, G, to the spindl lastly to the spring, J, which is connected with wire, O. Under these conditions this current a constant influence on the electro-magnet of phone without interfering with the ordinar mission of messages. By moving the point spindle, E, is rotated, and the cam, G, is moved away from the spring, H, and the c open. The cam, F, is then brought into conta finger, S, carried by a spring lever, K, support This lever is raised by the cam, F, and come tact with a projector, formed by a grain of attached to the diaphragm, M, near the centr circuit is then again closed, but the current p such a direction as to diminish the power of t net. The diaphragm, which was previously b certain extent about its centre, then tends by n its elasticity to return to its normal position, grain of platinum forming the projection away from the spring lever, K, the current interrupted, and the power of attraction of the is increased so as to enable it to attract the dia as before; the projection, is thus again bro contact with the spring, K, and so on in suc there are thus produced in the diaphragm, M, of vibrations, which are repeated in all the tel in the circuit. The arrangement of the cam sp acting as a communicator, and also serving t the diaphragm to act with a tremulous motion, the contact points to be moved for as small a as may be desired, and to thus adjust the appa pleasure.

5226. "Transmitting telephonic message ANTHONY MICHAEL FRANKENBERG. Dated De 14. 8d. Relates to certain improvements in of transmitting sound and messages by the use telephone, and embraces a system of district o telegraphs or telephones, in which the commu instruments of all the circuit stations are entire trolled in their functions or use and adjustm means of a battery and a transmitter at the n central station.

PROFESSOR AYRTON'S GALVANOME

A PORTABLE absolute galvanometer, devised b Ayrton, was recently described before the So Telegraph Engineers; through the kindness inventor we are able to give an illustration of th drawn to half full size. The needle is balanc consequently the deflections are about the same position of the instrumen moreover, the nee

pointer being very light and moving in a very strong permanent magnetic field, the instrument is dead beat in its action. By a proper arrangement of the coils the inventor has succeeded in making the deflections directly proportional to the current, and one degree deflection is produced by a current of two webers, the greatest deflection, 45°, being produced therefore by a current of 90 webers. The main peculiarity of the instrument, however, is the following:—The thick wire coiled round the needle, and through which the electric light current circulates, is in reality a strand or little cable composed of ten insulated wires. Each of these wires having the same resistance, equal portions of the strong current flows through each of them. To produce a deflection even of 5° requires, as stated, a current of 10 webers, but by means of this simple commutator these 10 wires, which have hitherto been



joined in multiple arc, can, by a mere turn of the hand, be connected in series, so that a current of exactly one-tenth part, or one weber, will produce 5° deflection. To render it impossible for the electric light current being passed through the coils when in series, the binding screws, marked P P, and to which the wires from the dynamo machine are attached, are only in circuit when the commutator is turned to parallel; the common screw, marked also S, and the third screw, marked S, being only in circuit when the commutator is turned to series. Neither the coils of the galvanometer nor the one-ohm resistance coil, then, can be damaged by the commutator being left accidentally in a wrong position.

City Notes.

Old Broad Street, May 26th, 1881.

THE BRAZILIAN SUBMARINE TELEGRAPH COMPANY (LIMITED).—The report of the directors to the fifteenth half-yearly general meeting, held on the 20th May, gave the accounts and balance-sheet for the half-year ended 31st Dec., 1880, and stated that the revenue for this period amounted to £82,084 6s., the working expenses to £11,743 18s., leaving a balance of £70,340 8s.; to this is added £4,103 17s. 11d., brought forward from the 30th June, 1880, making a total of £74,444 5s. 11d. After deducting income-tax, £1,133 10s. 2d., there remains a balance of £73,310 15s. 9d. First and second interim dividends, amounting to £39,000, have been distributed, leaving the sum of £34,310 15s. 9d. to be carried forward. The chairman, Viscount Monck in moving the adoption of the report and statement of accounts, said he might congratulate them upon the character of the report presented (hear, hear). It had been remarked, "Blessed is the country that has no history," and he thought the sentence applied *a fortiori* to public companies, because the history of companies that they had to give generally resolved itself into something injurious and detrimental to their Company. In the few observations which he should find it necessary to trouble them with, he should refer in the first instance to the state of their property. It continued in admirable condition, and the reports which had been made to them by their electrician showed that their cables continued as effectual as they ever were. That, in itself, was a matter of great congratulation, because that was the fifteenth half-yearly meeting they had held, and they had now got to a respectable age, and the fact that their cables were in solid and sound working condition was no doubt a matter of congratulation to the shareholders and to themselves (hear, hear). The receipts for the half-year had amounted to £82,000 odd. The profits of the half-year were £73,000 and a few pounds, showing an increase of £4,000, as compared with the corresponding half-year, which showed an increase of £4,580. On the last two occasions when he had to present these figures to them he had to draw their attention to the fact that, previous to the completion of the telegraph system to the Cape and up to and during the late Zulu war, they received a considerable increase in their receipts by telegrams sent home from the seat of war *via* Madeira. In the year 1879 they received from that source a sum of £3,700, which, of course, could not be reckoned as normal traffic; and as their traffic for the half-year ending in December, 1880, exceeded that of the half-year ending in Dec., 1879, including the sum of £3,700, it followed that their normal traffic had increased to the extent of £8,280 (hear, hear), which he thought was very satisfactory; considering also that if they would look at the table appended to the report, giving the monthly receipts from the first institution of the cable up to the end of the last half-year, they would see that there had been a gradual, although not a very large, and continuous increase in the traffic (hear, hear). He had also the pleasure of informing them that the traffic receipts which had been coming in since the 1st January last, and which did not appear in the present statement of accounts, showed a similar increase as the profits of the year. They had taken about £3,000 more than in the corresponding month of the previous year (hear, hear). He concluded by formally moving the adoption of the report, which was seconded by Sir James Anderson. After some discussion, the report was adopted, and the usual vote of thanks to the chairman and directors terminated the business of the meeting.

WEST INDIA AND PANAMA TELEGRAPH COMPANY (LIMITED).—The ordinary general meeting of this Company was held on May 18th, at the Cannon Street Hotel, under the presidency of Mr. C. W. Earle. The report stated that the receipts for the half-year to December 31st last amounted to £19,694. To this was added £5,841 brought from last half-year's accounts, and £5,372, an amount set aside in previous periods in respect of depreciation of the steamship *Investigator*, no longer required, making a total to the credit of revenue account of £30,908. The expenses had amounted to £28,952, leaving £1,956 to be carried forward. The chairman, in moving the adoption of the report and accounts, stated that the result of the whole year's working was a profit of £5,566, without

considering any depreciation for cables. This was a sorry result for so much expenditure and anxiety, but the reason of the exceptional bad year which they had had was not far to seek. The numerous interruptions of the cables accounted for the falling off in the traffic receipts, and the consequent repairs to the cables accounted for the large increase in the expenses of the cable repairs and shipping. The Company was largely dependent on the subsidies which it received, but most of the colonies stopped them when the cables were interrupted, so that they lost both the revenue and the subsidies. Of course under such circumstances their position was very difficult; and in addition to the loss at the time there was the damage to their credit. After referring to the alteration in the form in which the revenue account was presented, he alluded to the remarks made at the last meeting as to the expenses of the repairing ships, and assured them that they were bound to conform to the market price, and that it was of essential importance to have a contented crew to do the particular work required of them. With the view of obtaining some improvement in their position as to the subsidies, Mr. Grosvenor had been to the West Indies and placed the case before the various governments and the publics of those colonies; and he believed that, on the whole, the result would be a great amelioration of the existing terms. He next spoke of the improved position of the Company's affairs since the present board took office, previous to which the shareholders had not received a shilling of dividend. Mr. W. Ford seconded the motion, which was carried unanimously; and the retiring directors, Sir J. Anderson and Mr. William Andrews, were re-elected, as was also the retiring auditor, Mr. J. G. Griffith. The meeting then closed with a vote of thanks to the chairman and directors.

LONDON PLATINO-BRAZILIAN TELEGRAPH COMPANY.—The annual general meeting of the shareholders of this Company was held on May 23rd at the offices, Old Broad Street, Mr. Pender, M.P., presiding. The report stated that the interim dividend of 2s. 6d. per share, paid on November 1st, 1880, absorbed £4,793, leaving now in hand £13,650, from which the directors propose to appropriate £5,752 in payment of a final dividend of 3s. per share, carrying forward £7,898, pending the collection of the debt due from the Uruguay Government. The chairman, in moving the adoption of the report and the payment of the dividend recommended, referred to the Uruguay Government debt, and stated that as they were aware the South American Government were sometimes not in a very great hurry to pay, but they believed that the representations they were making by their agent, the exertions he was making to secure payment of the present monthly account of the Government, and the influence he appeared to possess, entitled them to look with some little hope upon the item as a good one. They had, however, so that there might be no question about it, set aside a sum equal to that amount, which would be retained in the position of reserve fund till they saw whether the amount was actually paid or not. As regarded the traffic receipts, although they were not large, still there was an increase. They hoped that the traffic would improve considerably with better times; but the improvement must arise not so much from the exertions of this Company as from those of the Western and Brazilian Company. That company had engaged this Company's cables, and this Company received one-fifth of all the earnings of that company, who also kept this Company's system in working order. The land lines which were under this Company's control had improved to some extent. The cable receipts were £18,590 last year, being an increase of £631 over 1879. He was rather disappointed at this increase, but as he had said they must look more to the Western and Brazilian Company for increasing the receipts. He then referred to the origin of the Company and the difficulties they had had in making it an English company under English law, from being a Brazilian company, and the improvements which they had since effected. The motion having been seconded, Colonel Tilney asked certain questions and submitted resolutions as to the directors, the fees, altering the articles of association, and in reference to the sending out of proxies with the directors' names printed on them, but the chairman replied, and Colonel Tilney afterwards withdrew them. The report was adopted unanimously, and the retiring director and auditors having been re-elected, a vote of thanks to the chairman and directors terminated the proceedings.

THE WEST INDIA AND PANAMA TELEGRAPH COMPANY (LIMITED).—The Demerara-Trinidad cable is repaired. The whole of this Company's stations in the West Indies are now restored to direct communication with England and the Continent.

IT is said that Mr. Jay Gould, in addition to his two Atlantic cables, intends laying cables to connect Brazil with New York direct, and also purposes making New York the centre of the telegraphic systems instead of London.

The following are the final quotations of telegraphs:—Anglo-American, Limited, 55½-56; Ditto, Preferred, 86⅞-87½; Ditto, Deferred, 27½-28; Black Sea, Limited, ——; Brazilian Submarine, Limited, 10¼-10½; Consolidated Telephone Construction, 4s. 6d. to 5s. 6d. pm.; Cuba, Limited, 9¼-9¾; Cuba, Limited, 10 per cent. Preference, 16½-17; Direct Spanish, Limited, 3¾-4¼; Direct Spanish, 10 per cent. Preference, 13-14; Direct United States Cable, Limited, 1877, 10¾-11; Debentures, 1884, 102-104; Eastern, Limited, 10-10¼; Eastern 6 per cent. Preference, 12¾-13; Eastern, 6 per cent. Debentures, repayable October, 1883, 104-107; Eastern 5 per cent. Debentures, repayable August, 1887, 103-106; Eastern, 5 per cent., repayable Aug., 1899, 106-109; Eastern Extension, Australasian and China, Limited, 11⅛-11⅜; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 109-112; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 106-109; Ditto, registered, repayable 1900, 106-109; Ditto, 5 per cent. Debenture, 1890, 103-105; Eastern and South African, Limited, 5 per cent. Mortgage Debentures, redeemable 1900, 104-106; Ditto, ditto, to bearer, 104-106; German Union Telegraph and Trust, 11¾-12¼; Globe Telegraph and Trust, Limited, 6¼-6½; Globe, 6 per cent. Preference, 12⅜-12⅝; Great Northern, 13-13¼; 5 per cent. Debentures, 103-106; Indo-European, Limited, 28-29; London Platino-Brazilian, Limited, 6-6¼; Mediterranean Extension, Limited, 2¼-2¾; Mediterranean Extension, 8 per cent. Preference, 9¾-10¼; Oriental Telephone, ⅜-⅝; Reuter's Limited, 11-12; Submarine, 270-290; Submarine Scrip, 2⅛-2⅜; Submarine Cables Trust, 101-104; West Coast of America, Limited, 4½-5; West India and Panama, Limited, 2¼-2½; Ditto, 6 per cent. First Preference, 7¼-7¾; Ditto, ditto, Second Preference, 6¼-6¾; Western and Brazilian, Limited, 8⅛-8⅜; Ditto, 6 per cent. Debentures "A," 104-108; Ditto, ditto, ditto, "B," 98-102; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 120-125; Ditto, 6 per cent. Sterling Bonds, 105-109; Telegraph Construction and Maintenance, Limited, 31½-32; Ditto, 6 per cent. Bonds, 107-110; Ditto, Second Bonus Trust Certificates, 3¾-4; India Rubber Company, 21-22; Ditto, 6 per cent. Debenture, 107-110.

HE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. IX.—No. 201.

IERE is every probability, we believe, that the ht cable question will again be brought to notice, d will demand public attention. It is now more an seven years since the idea was last energetically ken up by certain promoters, and it seems doubtful iether the revivification of the scheme is likely receive more public support than it did on the rmer occasion. There is plenty of capital floating out, it is true, which is ready to be subscribed for iy new enterprise which has precedents to recomend it, but the light cable scheme has no record of evious successes which can be pointed to as a kind guarantee of future success. If the project is ated it may possibly be a good one, but it is much ore likely, we think, to prove a costly failure. here will probably be no difficulty in sinking the ble to the bottom of the sea, but whether it will er be got up again in case repairs are required is iite another question.

Force et la Lumière Société Générale d'Electricité the latest thing in companies dealing with elecical matters, and £240,000 is the capital asked for. ie company (a Belgian one) has for its objects he production and use of electricity; the purase, manufacture and sale of electrical machinery d apparatus, and everything connected with ectricity; the supply of power and light, either by iy of sale, hire, or subscription; and the taking out, rchase and sale of patents bearing directly or inditly upon electricity and its several uses." Naturally th such an extensive programme before us we look see whether the Council of Administration of the mpany is such as to recommend the latter to iblic confidence. We are not surprised to find that e first name, of the three on the list, viz., Monsieur Philippart, Monsieur S. Philippart Fils, and lajor F. J. R. Seaver, F.R.S.E., is that of a entleman who is, we believe, as well known in ommercial circles on the Continent as Mr. Albert irant is in London. On the 16th of May, a corespondent to the *Times*, signed "F. I. R. S.," gave he first account of the conveyance from Paris to lasgow of a box containing active electricity in a ortable form; the patent for the arrangement of he contents of this box is amongst those secured y the company. It may be a coincidence, but we annot but be struck with the remarkable resemblance between the initials of the gentleman whose name stands last on the Council of Administration, and the anonymous correspondent, "F. I. R. S." We were not surprised, we repeat, to observe the composition of the directorate of the company, but we must confess that we were considerably taken aback to find that the consulting engineer for this speculative enterprise is one whose name is a household word in the telegraphic world, and whose connection with the company must give to the latter, in the eyes of the public, a far greater amount of importance than can, we believe, be possibly justified.

MOLECULAR MAGNETISM.

By PROFESSOR D. E. HUGHES, F.R.S.

(Received May 10th, 1881, read May 19th.)

(*Continued from page 203.*)

IT now occurred to me to try the effect of using a single pole of the magnet; this was done whilst a constant current was passing through the wire, commencing at the extremity, where the positive joined, drawing the north pole through the length of the wire, from positive towards the negative; the effect was most remarkable, as the steel wire now gave out as loud tones as a piece of iron, and the degree on the coil showed 200°. The constant and intermittent currents now showed for either polarity a remarkably strong right-handed twist; the positive 200 right, and the negative 150 right-handed spirals; the molecular strain on its wire from the reaction of the electric current upon the molecular magnetism was so great that no perfect zero would be obtained at any point, a fact already observed when a wire was under an intense strain, producing tertiary currents that superposed themselves upon the secondary. In order to compare these spiral currents with those obtained from a known helix, I found that taking a copper wire of similar diameter (0·5 millim.), and winding it closely upon the steel wire ten turns to each centimetre, having a total of 200 turns, with an exterior diameter of 1·5 millims., withdrawing the steel wire, leaving this closely wound helix free, that it gave some 190°, instead of the 200 of the steel wire alone; thus the spiral currents fully equalled a closely wound copper wire helix of 200 turns in a similar length.

If it were possible to twist a magnetised wire several turns to the right, and that its line of magnetism would coincide with that of the twist, then on passing a positive or negative current there would be an apparent augmented or diminished spirality of the current, but both would have a right-handed twist. The result would be identical with the phenomenon described, although the cause is different.

The explanation of this phenomenon can be probably found in the fact that the constant spirality now observed is that of the electric current under which it was magnetised, for whilst magnetising it we had a powerful source of magnetism constantly reacting upon the electric current, and the constant spirality now observed is the result or remains of a violent molecular reaction at the instant of magnetisation, and the remaining evident path or spiral is that of the electric current. On testing this wire as to its longitudinal magnetic force, I found that it was less than a wire simply magnetised in the usual way; thus the effects are internal, affecting

the passage of the electric current, giving, however, no external indications (except apparent weakness) of the enormous disturbance which has taken place.

If, instead of drawing the north pole of the magnet as above, from positive towards negative, I draw it from negative to positive, all the effects are repeated, except we have now, as we should expect, a left-handed spiral, but if I draw the magnet from the extremities of the wire to the centre, then at this centre I find an absolute zero of twist, but on each side a contrary twist, the wire then having a left and right-handed twist, the positive travelling towards the centre in a right-handed twist gradually ceasing in zero; this is as we might expect, but if done under the influence of a constant current, no matter what pole of the battery enters afterwards the north pole of the magnet, it will have during its first half a right-handed and its second a left-handed spiral. It became important to know if a wire which had been magnetised under the influence of a current could be restored to something like its original condition. Electric currents had no effect. Heat, which would not destroy its temper, had no effect. Mechanical vibrations and torsions failed to disturb the molecular arrangement; but magnetising strongly by a magnet, when no current was passing, at once brought the wire to its usual apparently rigid state, and the constant or intermittent currents now indicated only 18° of spiral currents against a previous 200°, and the sounds were, as usual from steel, excessively weak. I have since used this method with invariable success, when I wished to preserve or repeat the experiments upon the same wire. If these experiments are repeated upon an iron wire, the effects are far greater in the first instance, so great that they were thrown out of the range of my measurements; it was only after a few seconds of successive reversals that the zero of the wire was brought within range, and although these rapidly decreased, exactly similar effects were observed as in the steel, and as with all moderate ranges, I could bring the iron at once to a complete zero by torsion, and as torsion alone would produce this complete zero, I believe we have here effects from identical causes to those related in the first chapter.

Having noticed in my previous papers the increased molecular activity caused by the approach of a powerful permanent magnet, and believing that the permanent spirality above mentioned was due to this alone, and not to an increased polarity, I magnetised strongly an iron wire giving as usual a reversed spiral for different currents of but 10°. I now heated the wire by a spirit flame to a dull red heat, whilst the current was passing through it, and on cooling I found a similar but stronger permanent torsion of 250°; both currents, as in the previous experiments, having a right-handed spiral. Thus a current of electricity passing through a wire, nearly red hot, determines molecular arrangement, or path, which on cooling forces currents of either direction to follow the path which had been determined under the influence of heat.

3. *Molecular Sounds.*

The passage of an intermittent current through iron or other wire gives rise to sounds of a very peculiar and characteristic nature. Page in 1837 first noticed these sounds on the magnetisation of wires in a coil. De la Rive published a chapter in his "Treatise on Electricity" (1853) on this subject, and he proved that not only were sounds produced by the magnetisation of an iron wire in an inducing coil, but that sounds were equally obtained by the passage direct of the current through the wire. Gassiot, 1844, and Du Moncel, 1878-81, all have maintained the molecular character of these sounds. Reis made use of them in his, the first electric telephone invented, and these sounds have been, since the apparition of Bell's telephone, often brought forward as embodying a new form of telephone. These sounds, however, for a feeble source of electricity, are far too weak for any applied purposes, but they are most useful and interesting where we wish to observe the molecular action which takes place in a conducting wire. I have thus made use of these sounds as an independent method of research, and by their means verify any point left doubtful by other methods, some of which I have already described.

The apparatus was the same as in the last chapter, except no telephone was used. The intermittent electric current was connected by means of switch key, either with the coil inducing longitudinal magnetism in the wire, or could be thrown instantly through the wire itself, thus rapid observations could be made of any difference of tone or force by these two methods; a reversing key also allowed when desired a constant current of either polarity to pass through the wire under observation.

Iron of all metals that I have yet tried gave by far the loudest tones, though by means of the microphone I have been able to hear them in all metals; but iron requires no microphone to make its sounds audible, for I demonstrated at the reading of my paper, March 31st, that these sounds with two bichromate cells were clearly audible at a distance. A fine soft iron wire (No. 28) is best for loud sounds to be obtained by the direct passage of the current, but large wires (1 millim.) are required for equally loud tones from the inducing coil. By choosing any suitable wire between these sizes we can obtain equal sounds from the longitudinal magnetism or direct current. The wire requires to be well annealed, in fact, as in all preceding experiments, the sounds are fully doubled by heating the wire to nearly red heat. There are many interesting questions that these molecular sounds can aid in resolving, but as I wish to confine the experiments to the subject of the two preceding chapters, I will relate only a few which I believe bear on the subject.

On sending an intermittent electric current through a fine soft iron wire we hear a peculiar musical ring, the cadence of which is due to that of the rheotome, but whose musical note or pitch is independent both of the diameter of the wire and the note which would be given by a mechanical vibration of the wire itself. I have not yet found what relation the note bears to the diameter of the wire; in fact, I believe it has none, as the greatest variation in different sizes and different conditions has never exceeded one octave, all these tones being in our ordinary treble clef, or near 870 single vibrations per second, whilst the mechanical vibrations due to its length, diameter, and strain, vary many octaves.

I believe the pitch of the tone depends entirely upon molecular strain, and I found a remarkable difference between the molecular strain caused by longitudinal magnetism and the transversal or ring magnetism produced by the passage of a current, for if we pass the current through the coil, inducing magnetism in the wire, and then gradually increase the longitudinal mechanical strain by tightening the wire, the pitch of the note is raised some three or four tones (the notes of the mechanical transversal vibrations being raised, perhaps, several octaves); but if we tighten the wire during the passage of an electric current through it, its pitch falls some two or three notes, and its highest notes are those obtained when the wire is quite loose. A similar but reverse action takes place as regards torsion; for if the wire is magnetised by the coil we obtain an almost complete zero of sound by simply

: torsion index 45° on either side, and as this egree which gave silence in the previous ts for the same wire, it was no doubt due to otation of its polarised molecules. If we now ıstant current through the wire whilst the ıt one is upon the coil, we hear augmented t in pitch but loudness, and if we give torsion ne side we have silence, or nearly so, whilst iide it gives increased tones which become reversing the battery. If, whilst the wire by s been brought to zero, we decrease or in- mechanical longitudinal strain, then at once ed molecules are rotated, giving loud sounds; ther remark that when the wire is loosened, ıin tighten it, we gradually approach a zero, reasing the strain the sounds return; thus we the molecules by a compound strain of torsion ıdinal strain.

rish to notice the influence of a constant ssing through the wire under the influence ermittent current in the coil, we find that if is free from torsion that on passing the : tones are diminished or increased accord- direction of the current; the tones then have distinctive character, for whilst preserving ıusical pitch as before, the tones are peculiar, nd clear, similar to when a glass is struck, tones due to longitudinal magnetism are dull ng in metallic timbre. If we now turn the ırsion upon one side, we have a zero of sound thout the current; but the opposite direction reased tones whilst current is passing ıe wire, but zero when not. Here again a of timbre can be noticed, as although we tones due only to the action of the current e wire, the timbre is no longer metallic, but that previously given out by the influence of ridently then the metallic ring could only be angular polarisation of the molecules, and e were rotated by torsion the tones were ınged in its action upon the wire.

already shown that a permanent magnet ar the wire could rotate its polarisation, and it ı produce sound or silence in these molecular ring that the wire is at its zero of torsion, tant current sent through the wire as in the ment) we find that either pole of the natural ıs equal effect in slightly diminishing the n equal but opposite rotation from the line ximum effects; but if the wire is brought ero by torsion, then on approaching one pole ıral magnet we produce a complete silence, posite pole at once rotates the molecules to ım loudness, and on taking away the magnet ımparative silence as before.

the wire to nearly red heat by a spirit lamp he tones of longitudinal magnetism induced some 25 per cent., but it has a much more crease on the tones produced by the direct the current where they have more than 100 increase, and if we pass the intermittent ough the coil and constant through the wire, › direct rotation of the molecules by heat. ın apparent rotation takes places if we by ed torsion first place the wire at its zero, : application of heat faint sounds are heard, ›me again almost silent on cooling; this is : to the diminution by heat of the effect of torsion.

:d steel gave exceedingly faint tones, requir- ie of the microphone; but on magnetising nstant current, inducing spiral magnetism, s became audible, some 15° sonometer against 175° for iron; thus the molecular rigidity of steel as observed by previous methods was fully verified.

I have mentioned only a few of the numerous experiments I have made by the three methods described, all of which, however, bear directly upon the molecular arrangement of electric conducting bodies. I have selected a few bearing directly upon the subject I have chosen for this paper.

I have, I believe, demonstrated by actual experiments, which are easy to repeat, that—

1. An electric current polarises its conductor, and that its molecular magnetism can be reconverted into an electric current by simple torsion of its wire.

2. That it is by the rotation of its molecular polarity alone that an electric current is generated by torsion.

3. That the path of an electric current through an iron or steel wire is that of a spiral.

4. That the direction of this spiral depends on the polarity of the current, or that of its magnetism.

5. That a natural magnet can be produced, having its molecular arrangement of a spiral form, and consequently reversed electric currents would both have a similar spiral in passing through it.

6. That we can rotate the polarised molecules by torsion or a compound strain of longitudinal and transversal.

7. That the rotation or movements of the molecules give out clear audible sounds.

8. That these sounds can be increased or decreased to zero by means that alone have produced rotation.

9. That by three independent methods the same effects are produced, and that they are not due to a simple change or weakening of polarity, as when rotation has been incomplete a mere mechanical vibration has at once restored the maximum effect.

10. That heat, magnetism, constant electric currents, mechanical strains and vibrations, have all some effect on the result.

In presenting these results to the Royal Society, I desire simply to draw attention to the effects that molecular action can produce in its relations to electricity and magnetism, and it seems to me that a knowledge of the molecular actions taking place is a necessary step previous to knowing what magnetism is in itself.

IMPROVED ELECTRO-MOTIVE ENGINE.

The long-anticipated possibility of obtaining an effective and economical moving power from electricity has of late been proved both practicable and advantageous by the establishment of electric railways, of which I may mention that between Berlin and Lichterfelde, and the experimental lines at Düsseldorf and Brussels.

Nearer home an instance of the application of electricity to the propulsion of carriages may be inspected at the Crystal Palace. I do not, however, propose to enter at present upon a description of the electric railway, although my task may involve the elucidation of its leading principles. My object is to offer constructional particulars, applicable in the workshop, of a small electric engine of an improved and most effective type. The design of this motor is not covered by patent, so that it may be freely adopted by those whose business or pleasure pursuits require the application of small moving powers. This motor is well suited

to the driving of light machinery, such as sewing machines, dentist's engines, light lathes, light pleasure boats, electric machines of the static inductive kind, and so forth.

It may be stated at the outset that the motor is actuated by a current derived from the consumption of zinc in an improved form of cell, but it exhibits, when used for light purposes, a remarkably low figure of working cost when compared with other electro-motors.

In order to avoid recapitulating much information concerning electro-magnetism lately given in these columns, it will be necessary to assume, on the reader's part, a moderate acquaintance with the leading principles of that branch of electrical science.

A general perspective view of the motor is given in fig. 1, where *a* represents the base formed by prolongations of the main castings. With the base are cast a pair of iron polar extensions or magnetic inductors, *b*, *b*. These polar extensions carry screwed to them a large flat electro-magnet of the form shown; the core is of boiler-plate, it is wound with several layers of insulated wire, placed longitudinally, as shown. Between the polar extensions

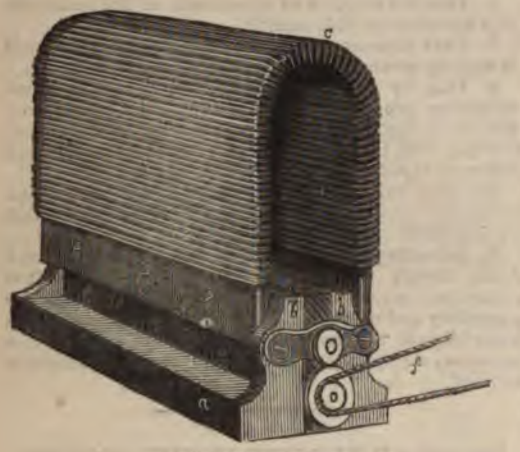


FIG. 1.

already referred to is mounted longitudinally a long armature of the Siemens' type rotating in a chamber at *d*; it has bearings, *e*, of gun-metal at either end of the motor. The power yielded by the motor is taken off for external purposes from a pulley driven by a pinion on the end of the armature axis, by the band, *f*. Having thus obtained a general idea of the leading peculiarities of construction, I proceed to sectional details.

The Armature.—This portion of the motor, being of the chief importance, demands attention first. Fig. 2 is intended to represent the armature removed from the engine. It is composed of soft cast iron, with an end section somewhat resembling an H girder in shape. The section at the foot of fig. 2, however, exhibits the actual form more accurately. The sides or polar faces are curved to correspond with the rotative motion of the armature. It will be observed that the enveloping insulated wire is wound upon the armature *longitudinally*. The peculiar shape of this armature is, therefore, the necessity for employing an envelopi wound in that position. The extremities, pieces, marked *a*, *a*, are cast with the ar They are of the shape shown in order t inducing coil of wire may be wound with The axis of rotation is, of course, in a line centrally of the length; it is represented extremity by a steel journal, screwed into t iron extension piece. One of these steel j carries a band pulley or pinion, and the other t *mutator*, or current reverser, to be further de

The *exciting coil* is represented in the sec of two layers, but in the actual armature i four layers. It is composed of one length of cotton-covered copper wire. It is woun tinuously in one direction longitudinally

FIG. 2.

sunk portion of the armature in four laye the extremities are finished off as directed he

The armature is cast from a smooth pat wood. Care must be taken to file away all ness, and especially to remove any sharp co the course of the wire coil. After being a to render the iron softer, the steel journ screwed into the end extensions and the centred and rotated "true" in the lathe, w faces are turned up in the usual manner. laying the wire the armature should, groove or sunk portion, receive two coat "japan," baked on, to obviate the possib metallic contact with the wire. The turne are not japanned. Prior to winding on the in

coil it should be drawn through a vessel of melted paraffin, to insure complete insulation.

Previous to winding the wire a small hole should be drilled in the end of the armature (the commutator end), in which the slightly tapered commencing end of the wire may be tightly and cleanly driven. This is to insure that one extremity of the coil is in electrical contact with the armature itself. The commutator, or current reverser, is shown at *b*, *c* (fig. 2). It consists of two cylinders of copper or gun metal; *b* is insulated from the journal by being driven over a sleeve of ebonite or wood; *c* is simply driven on the journal, and in metallic contact with it; therefore *b* is larger in its interior diameter than *c*. These cylinders are cut *obliquely*, as exhibited. When two contact springs, conveying a current of electricity in one direction, press at opposite diameters of the commutator, as shown in fig. 3, the current in the armature will, when it rotates, be reversed twice in every complete revolution; that is, a direct current will pass through it during one-half of the revolution, and an inverse current during the remaining half. In some instances the half-rings of the commutator are cut in a line parallel with the axis, but as this gives rise

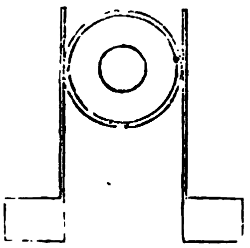


FIG. 3.

to a direct break of circuit at the instant of reversing the current, Mr. Wylde's method of dividing the commutator obliquely is to be preferred, since no actual break takes place. In order to complete the metallic circuit the free extremity of the inducing coil is, of course, brought out and soldered to the nearest (or insulated) half of the commutator.

When the armature is in motion the rate of rotation is frequently as high as 3,000 revolutions per minute. This gives rise to a considerable centrifugal effect upon the wire envelope, so that the wire convolutions are apt to fly outwards. To obviate this difficulty, two pieces of wood are placed over the wire, and secured in position by two brass end rings sunk in steps or depressions in the armature. This wood "lagging" is afterwards turned down to the cylindrical form, so that the armature presents the appearance of a complete cylinder. The active portion of the armature is 12 inches in length, its diameter from face to face 2½ inches.

Attention is now directed to fig. 4, which represents the motor in end section with the armature, *a*, *a*, in a portion of its revolution central of the two polar extensions before alluded to. They are cast from a pattern in ordinary cast iron. They are 13 inches in length. In order that they may present a uniform curved *face to the* turned armature, it is necessary to chuck them in a lathe with suitable separating pieces, and to carefully bore them out to the radius required by the diameter of the armature. The two sides, *e*, *e*, should be quite flat, in order that a perfect contact with the electro-magnet above may be secured.

The Field Magnet.—When the poles of an electro-magnet are attached to the two extensions, *b*, *b* (fig. 4), they become its poles, and a strong N and S polarity is exercised by them in the armature chamber. Hence the armature rotates in a powerful magnetic field, from which fact emanates the term field-magnet, as applied to the electro-magnetic portion of this motor.

c represents the body or core of this electro-magnet. It is composed of a piece of boiler-plate, ⅜-in. thick and 13 inches in length, curved to an ordinary U form, as shown. Its edges, when they come in contact with *b* and *b*, are planed true, to insure magnetic continuity. Before winding the

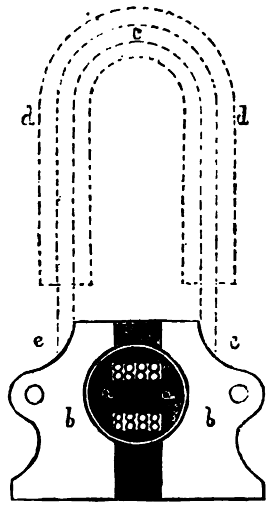


FIG. 4.

magnet with wire, all sharp or abrupt corners at its two ends are carefully chamfered off, and it receives two coatings of "japan" baked on, as before. Care must, of course, be taken that the planed edges are perfectly clean and free from japan.

Only two layers of wire are represented in the sectional figure; in the actual motor there are four. The wire is in one length of No. 14 cotton-covered, of the same kind as previously mentioned. It is wound on as usual in the case of common electro-magnets, four layers upon one limb first (or continued over the bend, as exhibited), and then crossing over to the other with the wire, describing an S curve in doing so. The object is to insure that the wire shall lie as it would were the coiling continued over the whole body of the magnet. The extremities of the wire are dealt with as hereafter directed. Each section should extend from the polar extensions upwards over one-fourth of the surface if not coiled over the whole body.

It is of the greatest importance to observe that

the armature chamber, besides being bored out true, must be only from $\frac{1}{16}$th in. to $\frac{1}{8}$th in. larger than the armature. The armature must rotate in very close proximity to the concave faces, otherwise much power will be lost, hence the necessity for accuracy in the preliminary steps.

When the parts of the motor are fitted together, the circuit arrangements must be made as follows: One extremity of the field-magnet coil is attached to a binding stud on the base. The remaining extremity of the field-magnet coil is attached to the contact spring on the same side of the axis. By these means the armature, springs, and field-magnet are included in the circuit of the electric source. The current, entering at the first binding screw, passes through the magnet, magnetising it, thence through the armature, and back to the source by the spring on the negative side.

The commutator must be adjusted so that the reversal of current in the armature enveloping-coil takes place at the instant when the armature is passing the medial line of the poles, or when it occupies the position shown in fig. 4. But the actual point of reversal cannot be accurately predetermined. The velocity of rotation is so great that a sensible time elapses before the magnetism of the armature is reversed, so that the reversing point may be rather in advance of the medial line, and this advance will be on one side or the other, according to the direction of the current and rotation.

The contact springs may be of hard brass, fitted to metallic blocks screwed to the insulating base; these blocks should be made with a slotted screw-hole, to allow of adjustment to the commutator. The specific electrical resistance of the armature wire is 0·4 ohm, and that of the magnet coil 0·8 ohm, making a total resistance of 1·2 ohm, which, however, is considerably increased when the motor is in action—an increase which is due to two causes, imperfect contacts and inverse electro-motive force, almost entirely, indeed, to the latter.

The Source of Electricity.—Any of the ordinary voltaic generators, such as the Bunsen or Grove, may be employed, but these are most troublesome and expensive in use. I have had in successful use a new form of constant bichromate cell, which I devised, after many failures, expressly for motors. This generator is represented in the accompanying sectional engraving (fig. 5). It consists of what is known as a single bichromate cell, but unlike this cell, it yields a current of constant strength for some hours at a time. A and B show a cylindrical earthenware vessel, deep and narrow. Two carbon plates and one zinc plate between them are used. *a* represents the carbon plate on that side. Both carbon plates are connected together with edge strips of ebonite fastened to them with cement. They thus form the sides of a *narrow cell*, similar to a Grove's flat porous cell. This cell and the zinc within it are suspended from a thick piston or disc of wood, made to slide in the containing vessel water-tight by packing in a groove, as at *c*, *c*. The disc and plates can be removed at pleasure by the ring, *d*. There are two openings into the narrow carbon cell, one through the disc, as shown, and the other at the opposite corner at *f*. The conductors lead off the current at *e*.

The object of the whole arrangement is, of course, to secure a constant stream or supply of exciting liquid to the amalgamated zinc plate. The cylindrical containing vessel may be imagined divided into three portions: the top third holds a supply of exciting liquid; the central portion contains the carbon cell with its zinc plate, and the bottom portion serves as a receptacle for the liquid as it slowly drops from the narrow outlet, *f*.

These cells act to perfection. When it is required to set the cell in action, the upper portion is nearly filled with a saturated solution of bichromate of potash (in hot water), to which is added sulphuric acid at the rate of 2½ oz. to each pint of solution. The liquid slowly percolates through the carbon cell, affording circulation at the same time, and maintaining the current at its full strength. The same liquid may be used twice, or even thrice. These cells call for no attention after being set up for several hours at a stretch, according to the bulk of liquid used and the rate of flow through the element.

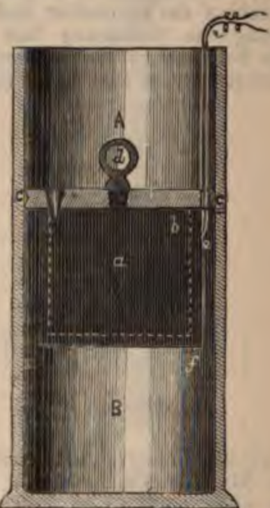


FIG. 5.

The size depends upon the work to be done. Three of such cells, with plates 5 × 6 inches, will suffice to drive a motor of the kind described. They must be joined up in series.

In the construction of the cell an air outlet should be provided at *e*, through the side of the vessel. The carbon plates must be well varnished on the exterior surface. The wooden disc must be carefully fitted and varnished. The zinc plates will be slowly consumed in the action, and may be replaced. It is found most convenient to fit the zinc plate in a groove cut in a piece of ebonite, fastened to the under surface of the disc—the same piece of ebonite may be made to serve as a plug upon which the carbon cell can be fitted. The conducting wires should be covered with gutta-percha. They may, if preferred, be led out through the side of the cell at *e*. The hand ring, *d*, may be extended upwards beyond the liquid, and may also be made to serve as an inlet tap, by means of which the action of the cell may be arrested, accelerated, or retarded at pleasure. A.

VYLE'S IMPROVED LIGHTNING CONDUCTOR.

THE object of this invention is to enable the condition of lightning conductors with respect to effectiveness of action or defects being readily ascertained. For this purpose the conductor is formed, as shown by fig. 3, with an insulated wire set within the core of an outer cable, the top of the insulated wire being metallically connected with the top of the outer cable, which latter is earthed at its lower end in the usual manner, whilst the insulated wire is carried from the bottom of the outer cable up to any suitable adjacent place above ground, and there connected with the key of a testing apparatus. The construction of the latter is shown by figs. 1 and 2; apparatus is depressed, when a deflection of the galvanometer needle takes place by reason of the passage of electricity from the battery through one coil of the galvanometer to the insulated wire set within the core of the outer cable, wire, or tube to the top, when it descends by this latter to the earth. Unless the continuity of the wire and cable be good, no current will be passed, indicated by the needle remaining stationary. By disconnection at a key, B, acting also as a switch, no current can pass through the other coil of the differential galvanometer, but on depressing B as well as A, the current divides itself equally between the circuit formed by the insulated wire and outer cable, wire, or tube, and a resistance coil, which should be made exactly equal to the other circuit; this being so,

FIG. 1.

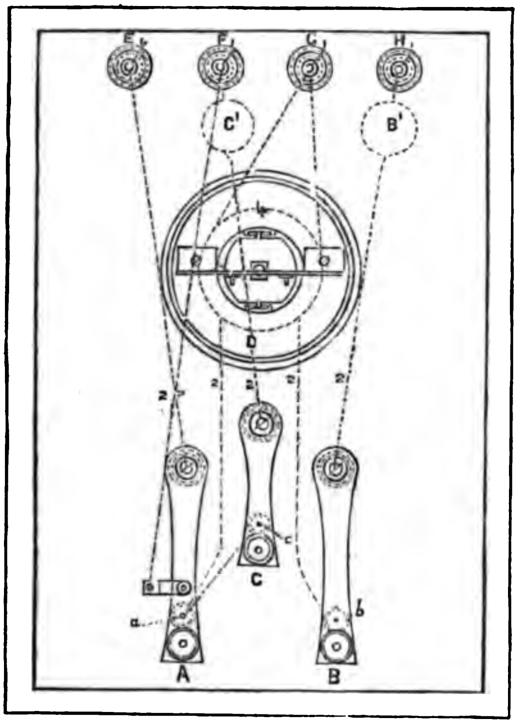


FIG. 2.

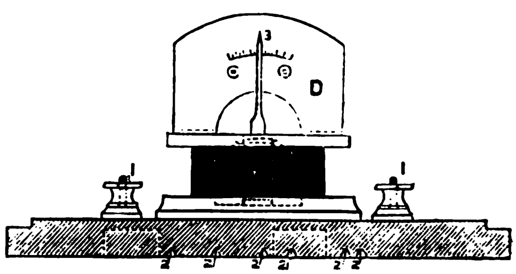
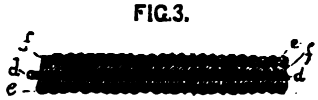


FIG. 3.



it consists of a differential galvanometer, battery, switch, resistance coils and connections.

Fig. 1 is a plan of the differential galvanometer and other parts of the testing apparatus, and fig. 2 is a cross section of the same. A is the key for the testing wire; B, key (or switch) to resistance coil, B¹; C, key (auxiliary) to earth of conductor through resistance coil, C¹; *a*, *b*, *c*, are studs leading to coils of galvanometer and battery; D, differential galvanometer; E, testing wire; F, conductor earth; G, one pole of battery; and H, ordinary earth and other pole of battery. 1, 1, 1, 1, are terminal screws; 2, 2, 2, 2, 2, 2, are connecting wires; 3, galvanometer needle; and 4, galvanometer coils.

In order to test the conductor or protector to ascertain its condition, the key, A, of the testing any defect in the lightning conductor or protector would betray itself by the needle not balancing, but showing a deflection. In such a case, an auxiliary key, C, comes into use, and its depression at the same time as B shows whether the earth of the conductor is good, or whether the fault is above ground, as the current is then divided between B and C, whose resistances are equal. If right, the needle should balance.

In the case of existing lightning conductors, an open copper or metallic wire insulated in the ordinary way with porcelain or other supports is fixed by the side of the ordinary conductor, and connected metallically at the top, this outside wire serving for the same purpose, and being operated in the same manner as the wire set within the coil, as above described.

NEW ELECTRIC LIGHT SYSTEMS IN LONDON.

JOEL'S SYSTEM.

ON the 2nd and 9th of June, an exhibition of the "Joel" incandescent electric light was held in the offices of the Prudential Insurance Company, High Holborn. The system is worked by Messrs. Rowatt and Fyfe's Electric Light Company, who are proprietors of the Krizik and Piette, or "Pilsen" lamp (see TELEGRAPHIC JOURNAL, December 15th, 1880, age 419).

The exhibition was a very successful one, and demonstrated well that the Joel lamp could replace with great advantage the numerous gas burners with which the building is at present lighted. Fourteen lamps were shown in operation, and they all burned with that remarkable steadiness which is characteristic of lamps on the incandescence principle. The power was obtained from a 20 horse-power engine, working on the evening in question up to 3½ horse-power only. A full description of the Joel lamp was given in the Number of this Journal for November 1st, 1880, and it is unnecessary to redescribe it here.

JAMIN'S SYSTEM.

M. BERLY has been energetically pushing forward the "Jamin" light, for which he is the engineer. Thirty of these lights are now employed to illuminate the Leicester Square Panorama. Several new improvements have been effected by M. Berly in the construction of the lamps, which have greatly added to their good working.

In all systems of electric candles with a movable carbon brought out up to now it has always been the custom to hinge the movable carbon on a pin as a centre of oscillation, the movable carbon being worked towards or away from the fixed one in some system (such as with the Wilde and Rapieff's) by means of a spring and the magnetism of an electro-magnet acting in opposition to each other, and in other systems, like the Jamin's, by means of the gravity or weight of the carbons themselves and their carbon-holders, and the similar action of an electro-magnet, also working in opposition to each other.

The use of a pin, or of points, as hinges in these various systems is found to be a very grave defect, as when alternating currents are used with electric candles, the vibration of the armature due to the rapid alternation of the current, causes the pin and its holder to soon wear out, and the resulting play is accompanied with the following inconveniences:—

1. From the pin playing into its holder, the shock of the metallic parts against each other is such that, although the play may be very little, the alternations of current are so rapid that it converts it into a musical sound, and a disagreeable metallic rattling noise is thereby created.

2. The armature, which is no longer held firmly, rotates in a different plane, according to the twist which the play of the pin may allow it to take; this twisting or deviation from the normal plane, and which may be very small, however small it is, is multiplied at the end of the long carbon pencils. Those being of a small diameter and of round section, and also, and consequently, very flexible, instead of fairly falling against each other when the circuit is broken, so as to be ready to light again, slide against each other, crossing each other scissors-like, and fail to produce the voltaic arc when they are brought apart by the action of the current being reinstated. In this case the carbon pencils fail to rise again until accident or good luck brings the points fairly against each other.

If, to avoid these two serious inconveniences, the pin is, or the points are, adjusted too fast, the stiffness of the joint or articulation prevents the free play of the movable armature or carbon-holder, and the lamp becomes ineffective—the carbons sticking against each other when they should part to produce the light, or remaining apart when they should touch each other's points, ready for lighting or when lighting. This last defect may also artificially arise, all being well before, from the dilatation caused by the heating of the lamp, or the position of the unequally worn-out centres.

Numerous schemes have been tried at very great expense of time and money, but without avail.

M. Berly has replaced the pin or points by a very broad, short, and thin piece of flexible material acting as a spring, and in his improved Jamin lamps the armatures may be said to act in the manner of an ordinary clock pendulum.

The said springs being very thin, nothing opposes the motion of the movable carbon towards or away from the fixed one; being very short they act as perfect centres of oscillation, and being very broad at the same time, no twisting motion of the armature can take place—no noise other than that of the arc existing in that new form of armature.

The thirty lamps lighting the Royal Panorama in Leicester Square have all been provided with M. Berly's improvements, and not a single one of that number has failed to do its duty for the two and a half months that the lighting of that establishment has been going on. These improvements, together with some others, have been patented by M. Berly.

MAXIM'S SYSTEM.

ON the evening of May 27th an interesting demonstration of the Maxim system of electric lighting by incandescence took place before a crowded meeting of political, financial, and scientific gentlemen at the Albany Works, 374, Euston Road, under the auspices of Mr. N. de Kabath, of New York.

The premises, which are very spacious, consist of two houses of four and six stories respectively, and it was here that, in the latter part of 1878, considerable interest was excited by the exhibitions of the Werdermann light, then considered to be the greatest advance towards the practical application of electrical lighting to all requirements.

At the back of the ground floor a 20 horse-power nominal engine, supplied by the firm of Messrs. Ransomes, Head and Jefferies, of the Orwell Works, Ipswich, and exactly similar to the engine which has been driving the electric lights on the Thames Embankment for two and a half years past, and of the same firm, was driving directly a group of three machines.

The Maxim system of incandescent lighting, which

is now successfully and very extensively adopted in the United States of America, and which was exhibited on the occasion referred to, is similar to those of Edison, Lane Fox, Swan, &c., in general appearance, the light being produced by the incandescence of a carbon filament inclosed in a vacuum globe, and the current supplied by a dynamo-electric machine of the Maxim design. On the evening of our visit there were 120 lamps at work, distributed all over the building, each lamp giving an illuminating power of about 20 or 25 candles during the first part of the exhibition, but afterwards being brought up to at least 40 candle-power each.

The burner itself is made of a carbon filament, manufactured from cardboard, and has the shape of a double loop contained in a glass bulb or hermetically-sealed globe, in which exists an atmosphere of vapour of gasoline, the presence of which, it is claimed, prevents the deterioration of the carbon-filament, a kind of renovating process constantly going on, and a layer of hydrocarbon being constantly deposited on the parts which, by becoming thinnest, offer an increased resistance and become unduly heated.

In Mr. Sawyer's book on electric lighting the following note occurs :—"An erroneous impression in regard to the Maxim lamp, due to the employment of gasoline in the process of exhaustion, is that it is a self-renewing device, *i.e.*, that whenever consumption or disintegration occurs the filament is repaired by an ever-present supply of hydrocarbon. The reverse is the case. When ready for use the globe contains a trace of gasoline vapour, and this is almost immediately decomposed, setting the hydrogen free, and leaving present a trace of hydrogen merely."

The two ends of the said filament are connected with the two poles of the machines, and a very ingenious contrivance which is attached to the burner allows of the light being instantly switched, or thrown in or out of circuit.

The duration or lifetime of the burner has not been ascertained yet, as the company working this system in America has not been in existence for a very long time, and many improvements have since been gradually introduced, but it is now claimed that the lifetime of the lamps such as were exhibited is from 600 to 900 hours.

The lamps can be taken out of and put back into their sockets as easily as an ordinary candle in a candlestick.

They can be fixed to any existing gas fittings, burners, or appliances. Gas fittings of every description were used for the purpose, from the commonest bracket up to the richest crystal chandelier and bronze foot lamps, a very nice selection of these apparatus having been kindly lent by the firm of Messrs. D. Hulett and Co., of High Holborn, for the whole duration of this exhibition.

The lamps were arranged in multiple circuit, each burner being perfectly independent of any other.

The main leading wire used was made of 19 strands of No. 16 copper wire; the main branch wire was made of 19 strands of No. 18 copper wire; the sub-branch wire was made of 7 strands of No. 16 copper wire; the lamp wires were made of one single wire, No. 14, or *No. 16 or 18, according* to the number of lights to be maintained in one branch. And all these wires were branched one upon another in exactly the same fashion as gas pipes are branched from the main pipe; and on the last-named size of wire (viz., a single wire, No. 18) six lamps can be maintained.

The gas fittings, when available, are used as a return wire; any other pipes, such as water pipes, &c., could be used for the same purpose, so that only a small wire is required for connecting all the lamps of one chandelier to the branch wires.

It is, however, in regulating the electric current supplying these lamps that Mr. Maxim's ingenuity is most appreciated by electricians and those conversant with the subject of electric lighting.

A small dynamo-electric machine, called the Exciter, running at about 800 revolutions per minute, generates a current of electricity which is caused to circulate in the electro-magnets of a large similar machine—the induced current of which is used entirely to feed the lamps—exciting therefore the magnetic field of the latter with which it is thus connected.

The small machine is provided with an extremely ingenious device for controlling the supply of electricity to the larger machines, thereby increasing or diminishing their magnetism, and regulating the current in order to suit, and according to the number of lights which may be burning. This machine is called the Maxim regulator, and, to give a general idea of it, it may be said that the brushes collecting the current generated by the exciter, together with the brush holders, are made to swing round the axis of the machine, and are automatically set to any position between the maximum and the neutral points.

Two pairs of electro-magnets at the top receive a proportion of the currents of the large and small machines respectively, one pair operating the regulating movement, and the other a shunt, which will be hereafter described. The regulator is operated by means of an armature attracted with forces varying according to the number of lights in circuit. When the supply of current becomes insufficient by more lamps being turned on, the armature being released in one direction, and attracted in the opposite one by means of an antagonistic spring, a pawl which is suspended from this armature causes the brush holders to revolve through an intermediary system of gearing being brought into play, thus supplying a greater volume of current.

The opposite phenomenon takes place when the current becomes too great owing to the removal of a certain number of lamps from the circuit.

The delicacy of the working of this regulator is such that—as was illustrated by Mr. Lockwood—the current supply is automatically, immediately, and effectively controlled, either when a large number of lights are in circuit or when there only remains one.

The other pair of electro-magnets are so connected and adjusted that they only act upon their armature when a large increase of the current passing through them takes place, such as would be the case should a main wire happen to accidentally break, or any other accident occur; in such a case this armature is strongly attracted, and overcoming the tension of its antagonistic spring, brings

its free end in contact with a platinum point, thereby cutting out of circuit the field magnets of the exciting machine, and completely stopping the generation of current until the accident shall have been remedied. This forms a perfect safeguard against any possible injury being done either to the machine or lamps.

Fully appreciating the advantages of this regulator, we published a well-illustrated description in our issue of November 15th, 1880.

The bobbins of the large machines are wound with two distinct sets of wires, each set being led to its own commutator; they may, however, be instantly coupled up for tension or quantity to suit the requirements of the case. When we inspected the system two large machines were excited by the smaller one, and supplying the current for the 120 lamps. Each bobbin of the large machines was coupled up for quantity, and the two machines connected together in tension.

The large machine runs at about 900 revolutions per minute. The regulator can be used to regulate and control from one to six of these machines.

Both machines are of a very highly finished workmanship, and resemble in their external appearance Siemens' dynamo machine.

They have been very carefully studied in all their details, and many of their parts, such as the commutators, the sections of which are made out in the shape of a very elongated or widely open letter V, instead of being in a straight line, as has always been done, the brushes, which are made of thin copper sheets instead of wire, the brush holder arrangement, the bearings, which allow of the position of the rotating coil to be regulated at will, &c., all constitute in themselves new and important features.

The lighting machine exhibited is called No. 20, and can give a single arc light of 20,000 candle-power. It is claimed to maintain 85 Maxim lights of 25 candle-power each, making an aggregate light of 2,125 candles, or 25 lights of 170 candle-power each. We have, however, already fully referred to these machines in our issue of December 15th, 1880.

The motive power required to drive it is 10 actual horse-power. The currents generated are of very feeble intensity, and no danger can possibly arise to a person from coming in contact with the metallic parts of the circuit.

This exhibition is by far the most important and the best that has yet been seen in London, both as regards the number of lamps employed and the great accuracy of action shown in the regulating apparatus.

These lamps can also be treated with considerable roughness in handling and transport without danger of breaking, and this alone constitutes an advantage which we have not yet seen in similar systems.

The carbon filament again seems to possess much greater tenacity than the carbons employed by Swan and others, for we are credibly informed that any one of Maxim's lamps will bear the passage of a current through the filament to raise its illuminating power to 800 candles or more without rupture or apparently suffering any deterioration.

Taking all into consideration, this system seems to be the most advanced and reliable of its kind, and it is to lights on the incandescent principle that we must look for the purposes of domestic use and interior lighting generally.

We believe that the Maxim lights will be maintained every evening up to the end of June, when all the apparatus will be removed to the Paris Exhibition.

The English patents have been sold to the Electric Light and Power Generator Company. The price *asked* was considerably over £100,000. The directors of that company have, we think, exercised a wise discretion in purchasing them, even for the large sum agreed upon.

Notes.

Hunnings' Telephone.—This form of telephone transmitter seems to be pushing its way in spite of the many rivals it has to contend against. The Darlington municipal offices have recently been telephonically connected together by means of the Hunnings' instrument. The new transmitter has been highly spoken of by Mr. G. L. Anders, electrician for the American Bell Telephone Company. Mr. Anders says:—"Having seen your Hunnings' Telephone Transmitter tested and in practical operation, it gives me pleasure to testify to the good results I have found. On a line 10 miles long (2 miles of which was underground) with many other wires, I found the articulation good, the volume of sound very great, the trouble from induction and adjoining wires practically nothing. The instruments are simple in construction, and, having no adjustments, are not liable to get out of order. These results are mostly owing to the practical manner in which you utilise a feature that has so far been overlooked in telephony. I see no difficulty in working lines of considerable length on this plan." The instruments are manufactured by Messrs. Cox-Walker and Company, of Darlington and York.

Production of Electricity by the Contact of Metals and Gases.—By M. Schulyer-Berger.—The author has undertaken a series of researches to ascertain if gases, like solids and liquids, produce a disengagement of electricity in contact with metals. The apparatus which he employs consists of a condenser formed of two metallic plates connected one with the ground and the other with a Thomson's electrometer. To determine the charge which the latter takes in different experiments the author opposes to it an electromotive force which he varies so that the needle of the electrometer may be brought to zero. One of these plates (the one connected with the soil) remaining always in the same condition, the other has been submitted to the influence of various gases, so as to modify the gaseous layer adhering to its surface. M. Schulyer-Berger has found, with the different gases employed, differences of tension varying according to the nature of these gases. He concludes that the contact of a gas with a metal produces a difference of potential between the two bodies, just as takes place in the contact of a metal with a solid or a liquid.—*Wiedemann's Annalen.*

On the Theory of Stationary Electric Currents, according to the Laws of Clausius, Riemann and Weber.—By J. Froehlich.—The author's purpose is to determine the conditions in which the laws of electric *actio in distans* can be brought in harmony with the stationary galvanic current. He considers the movement of the electricity in a part of the conductor very remote from the source of the current, so that in this part the electricities may act directly upon each other. The investigation consists of six parts. The first

contains general considerations and the equations of continuity for the interior and for the surface of the conductor, regarding the intensity of the current as a function of the co-ordinates and of the speeds. In the second part the author views the process of the current as a motion in resisting material where the resistance is directly proportional to the first power of the speed; but, as the force exerted respectively upon the positive and the negative unity of the moving electricity is generally not the same, Ohm's law is pre-supposed in the following manner: the force exerted upon the positive (negative) moving unity produces a positive (negative) current proportional to itself, the factors of proportionality being generally unequal. Thereby the equations in part 1 may be expressed by forces. In the third part the expressions of the forces which the electricities exert upon these unities according to the laws of Clausius, Weber and Riemann are introduced into the equations. Part 4 contains the equations of continuity calculated for the interior and the surface according to the three laws. In the fifth part the conditions of stationary movement are introduced (acceleration in the same element = O, and the density of the free electricity everywhere constant), but the density in the interior is not thereby rendered equal to null; as regards the speed and its direction for both electricities in one element of the conductor, nothing can be concluded. The outward action of such stationary currents is found in general in contradiction with experience. In order to bring the results into harmony with experience, the condition is introduced that in each element of the conductor both electricities move along one straight line and the currents corresponding to the several laws are considered separately.

For the currents according to the law of Clausius the density of the electricity in the interior is assumed = O, and the Lenz-Joule law is taken as valid. Hence it follows that both electricities must have a speed turned in opposite directions. The following experimental results are here utilised: on inverting the direction of the current the density of the free superficial electricity changes merely its sign, and in the same manner the total intensity of the current, whilst the sign and the value of the work performed by the current remain unaffected. The positive and the negative current must be proportional to the differential quotient of the potential of the free electricity, but are not necessarily equal to each other.

The currents according to Riemann and Weber pass over into stationary galvanic currents if the density in the interior = O and the speed of both electricities is equal and opposite. The empirical proposition is here introduced that the intensity of the current, other things being equal, is directly proportional to the density of the free surface electricity. To fulfil this condition the positive and negative currents are equal to each other and proportional to the force derived from the free electricity.

The result may be thus expressed: if we consider the stationary galvanic current in parts of the conductor very remote from the source of the current as a movement of electricities in a resisting medium, and the forces acting upon them as proceeding directly from other moving electricities, the stationary action possible according to the fundamental laws of electric *actio in distans* can be in harmony with experience only when the portions of the force dependent upon the movement of the electricities vanish in comparison with the static portion. This is generally the case only when the square root of the constants, k (belonging to the electrodynamic portion of the different fundamental laws), is very large in comparison with the velocity of the electricities in the conductor, and consequently in the stationary galvanic stream very considerable quantities must be in motion, a circumstance which does not speak in favour of immediate action *in distans*.—*Wiedemann's Beiblätter.*

ON THE ELECTRIC FIGURES OF PULVERULENT BODIES IN ISOLATING LIQUIDS, AND ON PECULIAR POLAR ACCUMULATIONS OF BOTH UNDER THE INFLUENCE OF ELECTRIC CURRENTS.—By W. Holtz.—An examination of the phenomena obtained on passing the current of an influence machine into insulating liquids mixed with pulverulent bodies. Even in the liquid alone accumulation or elevation is perceived, especially at the negative conductor. The pulverulent bodies attach themselves to both conductors, but especially to the negative pole. This is most striking with particles of camphor, carbon, and *semen of capodii*, whilst sulphur and several metallic sulphides prefer the positive conductor. The preference seems determined primarily by the chemical composition of the powders, and secondarily by the nature of the liquids. If the different powders are added to the liquid the one may paralyse the polar properties of the other. There are powders, apparently the best or the worst conductors, like sand and reduced iron, which cling to neither of the conductors. Especially with such there occur figured groupings at the bottom of the vessel, or in course of time dendriform structures. The figures resemble those of Lichtenberg if one of the conductors is ring-shaped. If both conductors are rod-shaped or pointed they are like the magnetic curves; but whether the figure in this case is annular or radiating depends less on the direction of the current than on its strength and on the nature of the powders. All the figures exhibit a two-fold movement; the particles move in their curves, and the curves themselves move round or between their conductors.

Certain metallic sulphurets display particular phenomena; they collect together here and there in balls, and these accumulations perform peculiar rotatory movements.

As the ultimate cause of the distinctive polar attractions the author suggests an unequal conductive power of the substances in question for positive and negative electricity. He makes also the conjecture that something similar may occur in aeriform media and may be the cause of the differences in luminous phenomena at the two poles.—*Wiedemann's Beiblätter.*

ON ELECTRIC EXPANSION AND ON ITS INTERVENTION IN THE CAPILLARY ELECTROMETER.—By M. J. Moutier.—The author has, some time ago, made to the Philomathic Society a series of communications on electricity which have remained overlooked by electricians on account of their too-strictly mathematical form, though they would have a real interest if the author had rendered them more accessible. Among these communications, which refer to the surfaces of level of an electrised ellipsoid of revolution, to the potential of an elliptical stratum of electricity, to certain experiments and calculations of Gauss and Plücker, to electric expansion, to observations on atmospheric electricity, to the theory of Lippmann's electrometer and the electroscope, we shall refer more particularly to those which relate to electric expansion and to the theory of Lippmann's electrometer.

It will be remembered that about two years ago M. Duter showed that the charge of a glass-plate condenser is always accompanied with an increase of the volume of the glass plate. This phenomenon had been observed a long time ago by M. Govi, but had not been thoroughly studied. M. Duter has established the law

that electric expansion is proportional to the square of the difference of the potentials of the two armatures, and is inversely as the thickness of the insulating plate. This law has been confirmed by the experiments of M. Righi, who alleges that, as far as concerns the relative effect of the insulating plate, the law cannot be deduced from the laws of Coulomb, and tends to establish a new property of electricity. M. Moutier, resuming the question, sought at first to explain the phenomenon of the change of bulk of a body exposed to electrisation by means of the theorem of Clausius on stationary movement; that is, the electric expansion of a conductor is equal to the third of the coefficient of compressibility of the body, multiplied by the potential of the electricity. In the case of a condenser, we may perceive that the electric expansion is proportional to the potential of the electricity, and he calculates the effects produced on this hypothesis in the different systems of condensers. In this manner he succeeds in demonstrating mathematically the laws proposed by Duter, without needing to introduce the hypothesis of a new property of electricity.

As regards Lippmann's electrometer, M. Moutier seeks the origin of the correlation between the electric phenomena and the capillary phenomena, which determines the movement of the mercurial column. For this purpose he calculates first, after Gauss, the sum of the virtual work of all the faces applied to the system of the two liquids, and he examines then the movements which ought to result for each of these liquids, movements which correspond to quantities with inverse signs. Then he concludes that, to obtain a displacement of the surface of the level of the two liquids, it is sufficient that one of the elements entering into the calculation should vary. He finds the origin of these variations in the phenomenon of electric expansion above mentioned, caused by the electrisation or by a variation of the potential of one of the liquids. Under this influence there is produced a variation of the volume of the two liquids, necessarily very slight and scarcely affecting their specific gravity, but which makes itself felt in capillary actions. Calculation shows that for one and the same variation of capillary constants the displacement of the surface of separation of the two liquids in the capillary tube is inversely as the diameter of the tube. Hence the use of very fine tubes in the construction of the capillary electrometer renders the apparatus more sensitive.—*La Lumière Electrique.*

REMARKS ON THE THEORY OF BJERKNESS'S PULSATING BALLS.—By Th. Schwedoff.—The author, as far back as 1870, had arrived at results similar to those of Bjerkness, *i.e.*, that a pulsating ball behaves like an electric mass or a magnetic pole. But instead of, like Bjerkness, supposing the two balls plunged in an incompressible fluid, he supposes them surrounded by a compressible medium. A complete analogy is then obtained with electric phenomena, similar masses repelling each other, whilst, according to the theory of Bjerkness, the opposite results should follow. Further, according to Bjerkness, electric masses are equivalent to magnetic poles, from which would follow a kind of electro-magnetic action not yet observed.—*Wiedemann's Beiblätter.*

THE NEW ATLANTIC CABLE.—The telegraph steamer *Faraday*, Captain Maypee, of London, which has been engaged laying the new Atlantic cable, arrived at Land's End on Wednesday, the 7th inst., to lay the shore end of the cable in Whitesand Bay. The work of landing the cable was at once proceeded with, and soon after ten o'clock the shore end was successfully landed.

THE Electric Railway between the Lichterfeld Station and the Central Cadet Institution has proved such a success that it has been decided to extend it. The line is first to be continued to Teltow, and subsequently to Potsdam. At road crossings the conductors of the electric current are in future to be laid under the ground, so that horses may not be exposed to a shock. This precaution is absolutely necessary. The other day a cab horse fell while crossing the steel rails when the current was in circulation, and another horse bolted from the same cause.

IT is stated that an electrical omnibus is to be run in Berlin.

A BRAIN, preserved and metallised by the galvanoplastic method, was lately presented to the French Academy of Medicine, on behalf of Dr. Oré, of Bordeaux. Dr. Oré's method (which preserves the brain entire) is briefly as follows:—The brain, having been so arranged that the circumvolutions are well separate, by introducing cotton wicks into the fissures, and so that the preserving liquid may penetrate the ventricles, is kept about a month in alcohol at 90 deg., so as to acquire good consistency; the wicks are then taken out. The brain is now plunged for ten minutes in an alcoholic solution of nitrate of silver (100 gr. per litre of alcohol), and carefully drained in air. Next, it is transferred to a case in which sulphuretted hydrogen is liberated, and it takes a dark hue owing to formation of a surface deposit of sulphide of silver. In about twenty minutes it is taken out, and after exposure a quarter of an hour in air, it is put in the galvanoplastic cell, where it soon assumes a fine metallic aspect.

GRATUITY FOR AN INVENTION IN THE POSTAL TELEGRAPH DEPARTMENT.—Upon the recommendation of the Postmaster-General, the Lords Commissioners of Her Majesty's Treasury have sanctioned the payment of a gratuity of £20 to Mr. Barnett, a telegraphist at Aldershot, who has devised an ingenious arrangement whereby an ordinary single-needle instrument can be converted into an acoustic instrument at a small cost.

MR. E. H. COOK proposes to apply the term "sonorescence" to the phenomena connected with the telephone and the conversion of intermittent radiations into sound.

JAMES GAMBLE, General Superintendent of the Western Union Telegraph Company, suggests that the telegraph might be used successfully in Arctic explorations. His plan would be to use light steel wire—say, No. 20 gauge—weighing about 20 lbs. to the mile. The wire, coiled on reels, could be hauled on sledges, either by men or dogs, over the snow or ice, paying it out as the advance exploring party went along. By this means the party would keep in constant communication with their base of supplies. The wire would also serve as a guide in case a relief party were telegraphed for. As hard frozen ground, dry snow, or ice is a perfect insulator, no poles to string the wires on would be required. An "earth" could be obtained by boring through the ice down to the water.

A VERY interesting experiment with a new molecular telephone, invented by Robert M. Lockwood and his son, William, of New York (see TELEGRAPHIC JOURNAL, May 15th, page 93), was tried recently between New York and Philadelphia over the ordinary telegraph wires. Conversation, even to a whisper, in Philadelphia was heard with perfect distinctness of articulation. The principle claimed by the inventors is that of molecular disturbance

uppression of all vibration. A company has ied to put the new telephone in practical use. ir.

RAPHS IN NEW SOUTH WALES.—At the comnt of 1880 the total length of telegraph con- n New South Wales was 12,426 miles, with ns. During the year 1,175,218 messages were ed, the revenue being £80,490, and the ex- £103,923. Compared with the previous year, an increase of 665 miles of wire, 37 stations, essages, £4,263 revenue, and £8,125 expendi- e total cost of telegraphic communication in y up to December 31st, 1879, was £437,120.

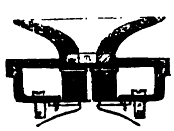
C BALANCE.—Prof. S. P. Langley, of the Observatory, U.S., has devised a new instruich is said to be considerably more sensitive ate than the best thermo-pile, and which he ctinic balance. The principle of the apparatus ed as follows:—A differential galvanometer— galvanometer with two equal coils of wire positely round the needle—has each coil con- circuit with a strip of thin steel, and the same irrent is split up between them. If the resis- the two steel strips are equal, the current will l into two halves, one half traversing one coil ther half the other coil. These two currents alise each other's influence on the needle, which in undisturbed. If, however, the temperature p is raised above that of the other by exposure e of heat, the hotter strip will increase pro- ely in its electric resistance, and the balance s on the needle will in turn be proportionately The deflection of the needle will in fact he change of temperature in the exposed strip. s employed by Prof. Langley are thin steel millimetre thick, ½ in. long, and $\frac{1}{20}$ in. wide, al of them are placed side by side to get a irface exposed to the heat rays. As at present d, the instrument is said to be from 5 to 100 ensitive as the most sensitive thermo-pile, and ity can be increased by coating the strips with k.—*Journal of the Society of Arts*.

ated that the Astronomer-Royal, Sir G. B. tendered his resignation. The office has been Prof. Adams, of Cambridge, who declined it, acancy will be filled by the appointment of , the Radcliffe Professor at Oxford, and he Astronomer at the Cape of Good Hope.

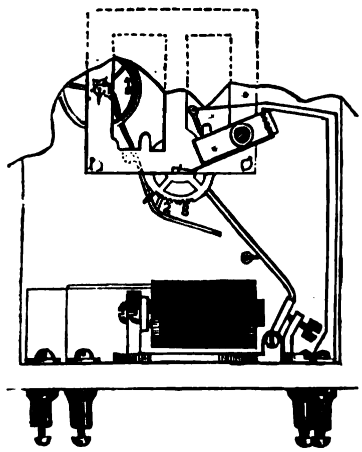
ankfort-on-the-Maine an electro-technical s been formed, similar to that in Berlin. The ng was in March last, and the president, Herr stated that 51 members had been enrolled. neetings will be held from October to May.

rks will begin immediately for the construc- International Exhibition Electrical Railway, uest of Messrs. Siemens has been granted by ipal Council of Paris.

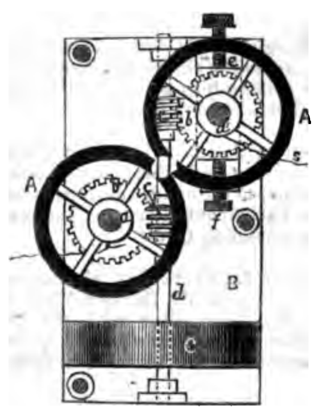
llowing patents have recently been taken out ted States:—No. 241,580. Clement Ader, of



magneto-telephone comprising, in combina- n electro-magnet and diaphragm, a piece or plate of soft iron in front of the poles of the magnet and on the opposite side of the diaphragm.—No. 241,598. Telephone signal. George Bliss. A number of synchronously-revolving circuit-controlling instruments for closing the circuits of signals at several stations are provided with means for stopping all the instruments whenever desired to ring the bell at any particular station, whereby sufficient time for signalling is secured. In this apparatus there is a mechanical motor or clockwork adapted to run

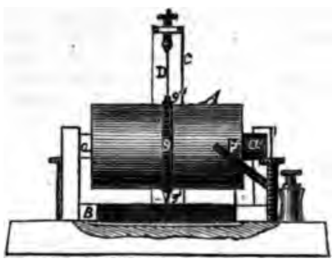


synchronously with the others of the series, and to control the operation of the corresponding signal, and stop mechanism for the motor, having a series of definite stop-points corresponding to the operative positions for the signals at the different stations, combined with the controlling-magnet for the stop mechanism, whereby an operator is enabled to start the controlling-motors simultaneously, and then stop them at any desired point at which a signal is in condition to be operated only at the station desired. The motor has a balance and a stop-lever, combined with the stop-cam, *h*, provided with a series of teeth or stop-shoulders. —No. 241,628. Electric lamp. William Buchanan.



This lamp has circular carbons, A, and A', with shafts, *a* and *a'*, and the gear-wheels, *b* and *b'*, in combination with the worm-wheels, *c* and *c'*, the shaft, *d*, and a mechanism for slowly rotating the shaft, *d*, the

bearings, *e*, and *e'*, are adjustable.—No. 9,708. Relay. Patrick Delany. In this relay there are two electro-magnets in the same circuit, one of which is fixed, while the other is suspended at a point



between its two poles so as to vibrate freely, and so that the extremities of its poles shall be respectively opposite the extremities of the poles of the fixed magnets, and shall be of opposite polarity thereto, whereby the greatest power of the current is utilised.

A MEETING of the directors of the Montreal Telegraph Company took place on the 27th ult. to consider the question of arrangements with competing lines. It was understood that two of the directors would shortly proceed to New York in connection with this matter.—*Liverpool Journal of Commerce.*

THE report circulated that the *Morna* had returned to London from the Western Islands, being unsuitable for cable repairing, is inaccurate. The *Morna* has repaired all the faulty cable on the west coast of Scotland, and is at present repairing the Isle of Man cable.

AT the thirteenth ordinary meeting of the Royal Society of Edinburgh, held on the 6th inst., a letter was read by Sir Wyville Thomson, who presided, from Mr. T. Usher of the Border's Association, soliciting the members of the Royal Society to unite with the Association in celebrating the centenary of Sir David Brewster by a dinner in Edinburgh on the 9th December next, over which Lord Moncrieff is to preside.

PRINCES STREET and part of the North Bridge, Edinburgh, are about to be lighted by the electric light.

THE Edinburgh Town Council, at a meeting held on the 7th inst., agreed to charge the Post Office an annual rental of one shilling for permission to lay underground wires in Frederick Street.

THE Society of Solicitors before the Supreme Court, Edinburgh, has resolved, through the National Telephone Company, to introduce the telephone into their library in the Parliament House for the convenience of the members attending Court.

THE ELECTRIC LIGHT IN THE HOUSE OF COMMONS.—Recently, in reply to Mr. Dillwyn, Mr. S. Lefevre said experiments had been made with the electric light. These experiments have since proved quite successful, and are to be continued. The system under trial is the Brush.

A NEW ONE-FLUID BATTERY.—At a recent meeting of the Royal Society of Edinburgh several communications were read, amongst them being an interesting one by Prof. Tait on an iodine battery by Mr. A. P. Laurie. This is a one-fluid battery. Zinc and carbon are employed as positive and negative plates. The strength of charge is 1 oz. of iodine to 2 oz. of water. The E.M.F. is about 1 volt. The force is constant and the elements can be left immersed for any length of time.

THE Clyde Lighthouse Trust have granted the request by Lloyd's Committee to erect a telegraph signalling station at Cumbrae for the benefit of shipping bound for the Clyde and English ports. Lloyd's Committee have also, it is stated, in contemplation the erection of two telegraph stations, one on Tory Island or Rathlin, and the other on Pladda or the Holy Isle.

THE non-restoration of communication between Shetland and the main land has caused great disappointment to the islanders and traders. A petition is now to be addressed direct to Parliament praying for a direct cable to Peterhead or Fraserburgh.

THUNDERSTORMS, resulting in loss of life and destruction of property, are reported as having passed over all the districts of England and Scotland during the past fortnight. The reports show that they were of unusual severity; thunder peal succeeding thunder peal in quick succession, and the lightning leaping forth in vivid flashes.

AN electrical railway is in process of construction at the Italian National Industrial Exhibition now proceeding at Milan.

ORIENTAL TELEPHONE COMPANY (LIMITED).—The first ordinary meeting of this Company, called in compliance with the Companies' Act, 1867, was held on the 3rd inst., at the City Terminus Hotel. Mr. J. PENDER, M.P., who presided, said that it might be interesting to the shareholders if he said a few words as to the present position and prospects of the telephone, which had been much before the public of late. Its object was to supply a want which thus far telegraphy had not been able to supply. For short distances people would not go to the expense of establishing a telegraph. Having taken a very active and important part in the progress of telegraphy, his only reason for taking an interest in the telephone in India was the belief that it might be worked in perfect harmony and prove a great aid to the telegraph system, and that a great work of progress might thereby be promoted. He thought that the success which had attended the operations of the telephone in America should be an encouragement to this Company. The telephone was established in America in 1878, and in 1879 it was established in England. The exchange systems in America at the present day numbered 132,692, and in England there were only about 15,000. The output of telephones in America for the year ending February last was 71,819. The reason that the system had not progressed so rapidly in England as in America was on account of the difference which had arisen between the Post Office and the Telephone Company. The postal system had endeavoured in the first instance to carry out the telephone system in the same way as the telegraph system had been carried out. He had always been opposed to the Government telegraph department undertaking to do more than it could do well; and he believed that England would have been in a better position with regard to telephones had it not been for the Government action. The Government, he thought, had been too slow with the telegraphs during the past ten years, during which period scarcely a new idea had occurred beyond those which had been brought from America. The Company was first going to commence its operations

in Egypt. It had only been formed four months, and he hoped before two more months were over that the telephones would be established in Cairo and Alexandria. The difficulty arose in India from the Indian Government being desirous of following the lines which the British Post Office had adopted, and as that matter had been for a considerable time under negociation their position there had been an undefined one. After frequent interviews at the India Office he was glad now to be able to say that the Indian Government had abandoned the idea of interfering with private enterprise in that direction. They had, therefore, now got a clear field, and he believed there was no country in the world in which the telephone ought to be more successful than in India, and he hoped that before the next meeting they would be able to report progress of a very material kind. Although the Company was not in any way related or bound to the Consolidated Telephone Company, the relations between the two were friendly, and the present intention of the board was to deal with Australia through that company, leaving India and Egypt to be dealt with by the Oriental independently. The meeting being of a formal character, no resolution was proposed, and the proceedings closed with a vote of thanks to the Chairman.

Books Received.

Electricity. By FLEEMING JENKIN, F.R.S. Society for Promoting Christian Knowledge, London.

Electro-plating. By J. W. URQUHART, C.E. Crosby Lockwood and Co., London.

Electric Lighting by Incandescence. By W. E. SAWYER, New York. E. and F. N. Spon, London.

Johnston's Illustrations of the Electro-Deposition of Metals. W. and A. K. Johnston, Edinburgh and London.

ERRATA.

Telegraphic Apparatus in Use in the British Postal Telegraph Department, Article XXXIV., June 1st, 1881. Page 209, par. 3, line 2:—*read* "t_1, t_2," *for* "t_1, t." Page 209, par. 8, lines 8 and 9:—*read* "connected to t_2. It is with this object that the tongue, t_2," *for* "connected to t_1. It is with this object that the tongue, t_1."

Correspondence.

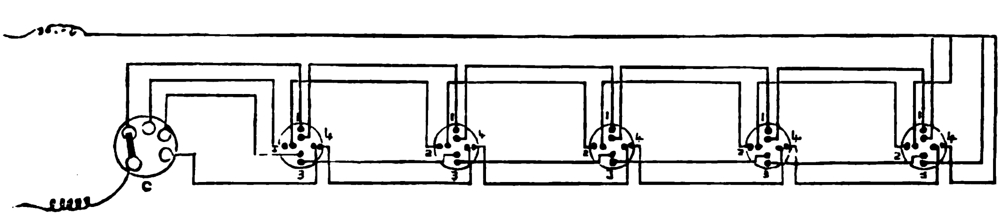
THE ELECTRIC LIGHTING IN THE CITY.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—In your issue of May 1st I notice a letter signed "Electron," criticising the electric lighting systems now being tried in the City. I will only deal with one portion of his discourse, viz., that connected with the "Jablochkoff candles." I will admit that the candle is simplicity itself, but the system in its working details is much more complicated at present than is generally known, and its economy cannot be admitted to compare with either "Siemens" or "Brush." When the Jablochkoff light was first introduced the candles were constructed to burn from 1½ to 1¾ hours, and it was necessary to send a man round to every lamp for the purpose of switching on by hand a fresh candle at the end of this time, so that for 8 hours' burning it would be necessary to go the round of the lamps three times.

This difficulty was overcome, however, and the candles are now switched on from the engine-shed by an arrangement (or rather complication) of wires, as shown in the following sketch of a circuit, and which assuredly cannot claim the merit of simplicity or economy. Each machine has 4 circuits, and produces 20 lights, and the lamps are arranged 5 in a circuit, and contain 4 candles each in most cases. In the engine-room is the commutator, having a wire led to it from the machine and attached to the contact lever. This lever, when placed in the left-hand knob or contact, diverts the current through the set of candles marked 1. When these are almost consumed (the time of lasting being known) the lever is switched on to the next knob, and the set of candles, 2, are ignited, and so on until the whole are used. It will be seen that the circuit consists of 5 wires, one being the return.

Now, taking the Thames Embankment, for instance, and an example of 20 lights, we have 4 sets of leads of 5 wires each, and each set of lights, as they get further away from the motor, must have proportionately longer sets of leads. Supposing the first lamp is 25 yards distant from the shed, and the lamps are also placed along the road at distances of 25 yards apart, we get the length of a wire to be 125 yards; there being 5 wires, the total length of the first circuit is 625 yards, the



second will be 1,250 yards, the third 1,875 yards, and the fourth 2,500, making the total length of cable employed for working 20 lights 6,250 yards, or over 3½ miles. This is, as before stated, for lamps containing only 4 candles each; if each lamp had 6 candles, 7 wires would be necessary for each circuit; if 8 candles, 9 wires, and so on.

I believe the arrangements for Waterloo Bridge are of a slightly different character, the commutators having wires led to them from the machine and being in a subway close to the bridge, so that it is necessary for a man to go down this subway about every 2 hours for the purpose of switching on fresh candles, the wires between lamps being the same as before mentioned.

A French invention of an automatic commutator of

a very complicated nature, and unfit for rough usage, has been tried, but I think given up again. Even had it been adopted it would still have necessitated the multiplicity of wires between lamps.

I need not enter into the already well-known facts in reference to the economy of continuous current and alternating machines, and will only say, that if a continuous current could be used for working the candles, probably 30 per cent. more lamps could be put in circuit with the same horse-power as now consumed.

I do not make these statements for the purpose of disparaging the Jablochkoff system, as I think and believe the whole arrangement could be much simplified and improved, and that it must eventually be done if the invention of M. Jablochkoff is to retain its deservedly prominent position in public estimation.

I remain, Sir,
Yours faithfully,
ELECTRICIAN.

52, Queen Victoria Street, London, E.C.
May 5th, 1881.

P.S.—I would refer "Electron" to the extract in the same issue of your Journal, page 170, on the "Economy of the Electric Light," by M. A. Vanderpol.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—The announcement that the Metropolitan Board of Works have accorded to the Jablochkoff system the renewal for lighting the Embankment is a matter of no small importance to those interested in the progress and development of electric lighting. Nearly three years ago the great Board who now manage our streets and bridges, and who are ever foremost in the van of progress, determined to try what could be done regarding the electric lighting of our roadways. At present, and until many of the new streets they are laying down are completed, this body have only the sole control over the Victoria Embankment and Waterloo Bridge (in its vicinity). *After* mature deliberation they determined to adopt for a trial the Jablochkoff system, and in their report of May, 1879, stated they did so for two reasons, its "simplicity" and "the number of lights that could be produced from one dynamo machine." The contracts were never for any long period—a year or six months—in each case of renewal a reduction in price following, until now, after this long trial, they have accorded to the Jablochkoff system the lighting of our finest thoroughfare for three years at a price which will give the light at a rate equal, if not lower, than gas, at the same time increasing its power six-fold. This speaks volumes. The *Metropolitan* Board of Works are a body comprised of members from all the various and varied municipal bodies of London, and the decision of these gentlemen should be of value to, and highly appreciated by, all those who desire to see a pure and innocuous light substituted for one which cannot be styled pure and is certainly anything but innocuous. When the trial at present going on in the City was proposed and agreed to, three systems were chosen; of these the Jablochkoff formed one. The reason of its inability to complete its agreement has been more than once mentioned, and it is unnecessary to allude to it here, save so far as to state that it had nothing whatever to do with the system itself, but arose simply from a legal difficulty preventing the company who had taken it up carrying on their operations. When the first lighting of the City took place the remarks made by many of the press regarding the great superiority of Brush and Siemens were positively nauseous, while disparaging. Touching *the "Embankment light,"* what has the result been? Siemens has been in and out and up and down the pole, Brush out occasionally, and for a considerable time out altogether, while, to quote the words of Mr. Rogers, at the meeting of the Aldgate Ward Ratepayers' Association, "The Thames Embankment had been lighted by electricity for the last three years, and that light had not failed for a *single hour*." There has been, I think, perhaps it ever will be so, too much eulogy bestowed on what is new or novel, with an inclination to cast a slur on a good old servant; it must, therefore, be a matter of great satisfaction—nay, triumph—to the holders of the Jablochkoff patents to feel that, after so long and exhaustive a trial, and with now other systems brought so close to the scene of their own labours, the most important and powerful corporation existing, seeing no cause to alter their first decision, have given them the contract to light their "great thoroughfare" for so long a period as three years.

Yours obediently,
R. SPEAR BEGBIE.

Junior Carlton Club.
June 8th, 1881.

TELEPHONIC PERTURBATIONS.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—M. Gaiffe, in his recent communications on Telephone Perturbations, shows that much of the disturbance heard in the telephone can be traced to causes other than induction. He says the rubbing together of two wires produces sound in the telephone, and surmises that imperfect joints when moved by the wind will do the same. This surmise is confirmed by observations, and also that loose binders and insulators are equally productive of commotion.

On two aerial lines, each about 2½ miles long, having all joints soldered and no wires near them, ticks at the rate of about three per second were distinctly heard in the telephone. These sounds may have been caused by one of the defects already mentioned, but as an inspection of the lines showed them to be in good order, it is more probable that they had their origin in the currents set up in the wires by the vibratory motion given to them by the wind, which was moderately strong at the time.

Another source of disturbance is found in the common practice of putting telegraphic and telephonic circuits to the same earth-plate. Separate earths should always be provided, because when this is not done every movement of the telegraphic apparatus is distinctly reproduced in the telephone. Care should also be taken to insure that the earth-plates are of the same metal; if they are not, a current, as is well known, will be set up, which generates sounds in the telephone analogous to, and which are readily taken for, those induced by neighbouring wires. To prove this, one end of a telephone circuit was earthed through the main water pipes of the town, and the other end through a copper plate four inches square put into the earth. The sounds heard in the telephone, though not so loud, were in other respects similar to those created by a proximate circuit working at high speed, and were entirely removed when both ends were connected to the water service.

Although it would appear that after a time the ear rejects many of these abnormal sounds, still if the telephone is to be a complete success, they should as far as possible be eliminated, and this fortunately can be done to a very considerable extent by careful construction and supervision.

I am not aware that any arrangement has yet been made for fitting telephone circuits with galvanometers.

At present A has no indication when calling B that the current is going to line all right. If B fails to answer, uncertainty prevails as to the cause, which may be inattention, a wire accidentally knocked off its terminal, or a fault in the apparatus at either end. The trifling cost of the galvanometers would be more than repaid by the saving of time in discovering the existence of faults and where located. Reuters, I am sure, would willingly undertake to make the necessary tests, if supplied with a few simple rules for guidance, as much inconvenience and time would thereby be saved to themselves. The gain to the maintainers is obvious; unnecessary travelling and other expenses would be avoided as the "Advice of Interruption" would indicate where the lineman should be sent.

Yours truly,

Edinburgh, *6th June*, 1881. TELEPHONE.

Proceedings of Societies.

PHYSICAL SOCIETY.—MAY 28th.

Professor FULLER, V.P., in the Chair.

MR. C. WOODWARD exhibited apparatus for illustrating wave motions to a class. This consisted of a number of glass panes of equal size, mounted on stands so that they could be ranged in a line, or in rank and file. Patches of blue paper were attached to them to represent the moving particle of the wave, the positions being determined by a diagrammatic card which fitted each pane. A machine for showing Fresnel's conception of polarised light consisted of two axles fitted with a number of cranks which supported a roof of rafters bearing at their ridges a number of beads to guide the eye in tracing the wave motion. By turning the axles the cranks shifted the frame of rafters and the beads displayed the wave motion, which was vertical, elliptical, or circular, according to the adjustment.

Prof. G. FORBES explained the experiments made by him and Dr. Young to determine the velocity of light. The method employed was that of Fizeau, but instead of having one distant reflector and observing the total eclipse of the reflected ray by a tooth of the revolving wheel, two reflectors, one a quarter-mile behind the other, were used, and two rays, which were observed when of equal brightness. This method was found more accurate than Fizeau's own plan, and gave curves of brightness. The speeds of the toothed wheel were adjusted until the two rays appeared of equal brightness. The general result was that the velocity of the light of an electric lamp is 187,200 miles per second; Cornu found the light of a petroleum lamp to be 186,700 miles per second; and Michaelson that of the sun to be 186,500 miles per second. The higher number of Prof. Forbes is probably due to the bluer light of electricity, for further experiments made with coloured lights and the spectrum seemed to prove that blue light travels probably over one per cent. faster than red light. The experiments were made at Wemyss Bay in Scotland.

Mr. SPOTTISWOODE, F.R.S., said he had followed Prof. Forbes with interest, and these results appeared to modify our ideas of the luminiferous ether.

Lord RAYLEIGH inquired why it was that Jupiter's satellites showed no difference in tint on emerging from eclipse if red and blue rays travelled with unequal velocities.

Prof. FORBES believed it due to the gradual character of the emergence of the satellites from behind their primary. According to the new theory variable stars should, however, be bluish, with an increase of their light.

Prof. G. C. FOSTER pointed out that dispersion of the light in the air would rather have had the effect of retarding the blue rays.

Mr. HALE, of Baltimore, U.S., then exhibited the experiment in which a current of electricity, flowing longitudinally along a thin foil of metal, is caused to yield a transverse or lateral current by inserting the foil between the poles of a magnet. The lateral current is observed on a sensitive galvanometer, and care is taken in the first place to find points of connection with the foil which yield no current before the magnet is applied. The results were that if iron is called +, the series is, iron, +; silver, —; gold, —; platinum, —; tin, —. Curiously, nickel, though a magnetic metal, like iron, is —; but on inquiry of Prof. Chandler Roberts, it proved that the nickel employed was, perhaps, too impure. Cobalt ranges between iron and silver, and is +, like iron.

Prof. PERRY suggested that the displacement and huddling of the lines of flow of the current by the magnet might cause the current; but

Mr. HALE said that an experiment had been tried to test that, and went to prove that it was not due to crowding of these lines.

The SECRETARY read a paper by Prof. J. H. Poynting on the "Change of Bodies from the Solid to the Liquid States." There are two types of change, exemplified by ice-water and by sealing-wax; in the one a surface melting at the same temperature, in the other a softening of mass and heating. The first was thought by Prof. Forbes to be a limiting case of the second type; but the author gives reasons for supposing that it is rather an exchange phenomenon analogous to what takes place when water evaporates, and the melting point is reached when the number of molecules passing from the ice to the water is equal to the number passing from the water to the ice. The sealing-wax type is analogous to the change of state in a liquid gas above its critical point, where it changes gradually from a rather liquid to a certainly gaseous state.

THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.

AN ordinary general meeting of this Society was held on Thursday, May 26th, Prof. CAREY FOSTER, President, in the chair. The minutes of the last general meeting having been read and confirmed, and the list of new and proposed members announced, a paper was read by Mr. P. V. LUKE, C.I.E., on "The Construction and Working of a Military Field Telegraph (based upon experience gained during the Campaigns in Afghanistan in 1878-79-80)." The President prefaced the paper by reading a letter from General Sir F. Roberts, who regretted that he was unable to be present, more especially as he was greatly indebted to Mr. Luke for valuable assistance given.

The work done during the Afghan campaign was of a highly interesting nature, as the Field Telegraph accompanied the expedition throughout the whole period during which the campaign lasted. The total length of line erected was 500 miles, that up the Kyber Pass being 180 miles, viz., from Peshawur to Kabul. In 1878 the line was open to Ali Musjid, but was destroyed by the Afghans. In 1879 the line was taken to Bosawl, a distance of 58 miles. The line was interrupted no less than 98 times, the wire being stolen

and never recovered. On the 3rd October, 1879, the line was begun again, and on the 21st October it met the sapper line 9 miles from Jellahabad. The line in the Kurum Valley worked uninterruptedly for some time, but was cut on the 15th October, but all urgent telegrams were got off on the night of the 14th October. In the second campaign the wire was carried all round the Kabul cantonment; it was cut 50 times and 57 miles stolen.

As regards the general construction of lines, he would observe that Mr. Preece, in his Chatham lectures delivered before the Royal Engineers, divided field telegraphs into three parts, viz., the permanent, the semi-permanent or flying, and the visual line. The latter, worked by the heliograph, could be worked with stations 40 miles apart, but was disadvantageous, inasmuch as the signals could be read by a civilised enemy, although in Afghanistan of course no such disadvantage existed.

It was no use constructing a line unless it could be protected. Two kinds of line could be used, viz., an open and an underground line. Three miles of the latter covered with hemp and unburied had been tried, but it was always cut.

In constructing an overland line difficulties arose from the absence of timber for poles; from Peshawur to Kabul, for a distance of 40 miles, no wood could be obtained; on the rest of the route, however, plenty of timber was available. 10 or 12 miles of poles at the basis of operation were required. As regards the kind of poles to be used, it was found that bamboos could be employed with great advantage, as camels could transport them in lengths of 20 feet. Jointed poles were stated to be of no use. Two poles tied together at the top like a pair of shears were useful sometimes. Bullies or saplings were also used. Heavy poles were of no use.

Insulators could not well be employed, so the wire was set in a nick in the bamboo and bound there. The wire weighed 300 lbs. per mile, and was transported in coils of 100 lbs. each covered with tarred canvas.

Tools for digging holes for the poles were necessary; those with crank handles were useful.

Amongst other *matériel*, tents for the working parties and for offices were used; the large size, to hold twelve natives, weighed 120 lbs; a smaller form of tent weighing 32 lbs. was also employed.

The office equipment consisted of sounders, Siemens' relays, lightning protectors, trembling bells, galvanometers and clocks; the batteries were Minotto's, in boxes holding twelve. Leclanché's were also tried, but the best form of battery had certainly not yet been arrived at. Stationery and tools were also carried, together with furniture for placing the apparatus on, &c.

The actual weight carried was 160 lbs. for each mule, there being 5 mules for each office.

The working parties consisted of 1 inspector and 20 men, with 57 mules.

The men most suited for the work were those of pioneer regiments. Three to four miles a day could be erected, or 90 miles per month, in a dangerous country. The wire should always be in sight of the road. Twisted joints were employed which were not soldered.

The protection of the line was best effected by subsidising the villages and making the latter responsible. As the wires were always cut at night great difficulty was found in capturing the delinquents; this was effected once by putting a permanent current on the line with a bell in circuit.

Each office was provided with 5 miles of spare wire. Faults were usually remedied in a few hours by the linemen who patrolled on either side of an office.

The great uses of the telegraph were to give notice of an impending attack and to give transport instructions.

Double lines were erected over part of the distance, as the traffic was very heavy.

In cases of a break the broken down section was signalled across by the heliograph when possible. In any case the heliograph was a most useful supplement to keep up communication.

Military signallers were employed and found to work best. These could send at the rate of 15 words a minute, and receive at 12.

In the discussion which followed the reading of the paper,

Lieut.-Col. WOODTHORPE, R.E. said that it was a great advantage to surveyors in making a survey to have a line of telegraph. Visual signalling was very useful where possible, but in ravines it cannot be carried on. As a matter of fact, no country possesses such advantages for heliography as Afghanistan. The Cape was also good in this respect, though the rain seriously interfered with it.

Major ARMSTRONG said that the paper had called attention to the want of organisation, which was a serious matter. The employment of the military to work the telegraph system should, he thought, be encouraged. He agreed with Mr. Luke in thinking that a portable battery was a great want.

Mr. C. E. PITMAN, C.I.E., said that the rate of signalling mentioned by Mr. Luke as being attained by the military signallers was too high; he did not think that a greater speed than four or five words per minute was attained as a rule. The batteries he had employed were Minotto's, in two rows of five, packed in boxes with wadding and felt; the zincs were taken in a separate box. The Marie Davy had been used in the Looshai campaign with success. Insulators, he thought, were certainly required in certain countries. As regards the interruptions which took place, he thought they might have been avoided if proper precautions had been taken. In the line he had erected to Candahar he had had the natives who caused an interruption very severely punished, and with excellent effect, as the line was then left unmolested. 140 miles were worked without more than two interruptions.

The collection of stores for the line was left to the stores department; the materials were issued at once on being requisitioned for by telegram. He thought that the line to Candahar should be made a commercial one, and if this was done there was no reason why the line should not be carried on to Herat, 220 miles from Meshud, where the Persian Gulf line joins, thus completing a line to England direct, in which case the rate for telegrams might be reduced from 5s. to 1s. per word.

The poles used for the Candahar line were teak saplings, bamboos, plane poles, willow, and poplar, the poles being 17 feet 9 inches long, 3½ inches at the base, and 2¼ at the top; bamboos were chiefly used at road crossings; the spans varied from 70 to 130 yards.

The greatest load a camel could take was 350 lbs. Carts were employed for some portion of the distance until they fell to pieces. He remarked that during the siege of Candahar, the signalling staff, who were Afghans, remained faithful.

Major WEBBER agreed in condemning the use of a ground line for military purposes. In the Cape no poles could be obtained; those which were used were brought from India and Brazil. He did not think that joints in poles were weak points; tube joints could be made with great success, in fact, the poles he had employed were in very short lengths, and seven or eight thousand were used. As regards insulatots, the use of them entirely depended upon the climate. No. 9 wire

was very good for military purposes, but No. 11 was still better; Lieut. Jekell had used the latter in the Ashantee campaign. In India war was made without any preparation for military telegraphs. The fact that the departmental and sapper lines were constructed together showed the necessity of some organisation. He would remark that the present paper was the first one on Indian telegraph construction that had been brought before the Society.

Mr. JOSEPHS thought that the friction between the two departments might be avoided if a certain number of men in each regiment were instructed in telegraph construction and signalling, so that each brigade could do the work as they advanced.

Major HAMILTON stated that, at the Cape, some insulated wire laid on the ground worked well until destroyed by grass fires. He said that he had tried experiments with a bare wire laying along the ground, and worked by means of a telephone receiver and a Theiler buzzing sounder (TELEGRAPHIC JOURNAL, Feb. 15th, 1879, p. 63) in circuit with the sending battery and key; the signals were perfectly distinct, even when the wire was laid in a canal and severed in the middle.

Mr. PREECE said that during the late Ashantee scare, 20 miles of line, fully equipped with men, had been got ready for shipment by the Postal Telegraph Department in three days. He was glad that the sounder had been so much used by military men; he had always advocated its use.

After a few words of reply, the meeting adjourned till the 11th of November.

New Patents—1881.

2304. "Manufacture of apparatus for the exhibition of the electric light." W. CROOKES. Dated May 25.

2323. "Secondary electric batteries." J. H. JOHNSON. (Communicated by La Société la Force et la Lumière, Société Générale d'Electricité.) Dated May 26.

2331. "An improved system of hydraulic telegraphs." Comte C. DE MONTBLANC and L. GAULARD. Dated May 27.

2334. "Improvements in and in furnaces used in the metallurgy of copper, and in the method of varying the electrical conductibility of copper. A. M. CLARK. (Communicated by J. Garnier.) Dated May 27.

2344. "Electrical lighting apparatus." P. L. M. GADOT. Dated May 27.

2369. "A new or improved lamp with automatic regulation for the purpose of lighting by electricity and effecting a regular and uniform approach of the two electrodes, candles, or carbons, in proportion as they are consumed. S. COHNE. Dated May 30.

2375. "Improvements in magneto-electric machines, and in permanent magnets for magneto-electric machines, for magnetic telephones, and in the magnetising of such magnets." H. E. NEWTON. (Communicated by C. A. Hussey and A. S. Dodd.) Dated May 31.

2394. "Electric circuits." S. PITT. (Communicated by O. Lugo.) Dated May 31. *Complete.*

2398. "Telephones or vocal sound telegraphs." R. M. LOCKWOOD and W. VAN O. LOCKWOOD. Dated May 31. *Complete.*

2402. "Electric lamps." G. HAWKES and R. BOWMAN. Dated May 31.

2416. "A magneto-electric machine." F. WOLFF. (Communicated by C. P. JÜRGENSEN and L. V. LORENZ.) Dated June 1.

2437. "Metallic circuits for electrical transmission." E. EDMONDS. (Communicated by G. M. Mowbray.) Dated June 2. *Complete.*

2449. "Apparatus for measuring mechanical electrical power." C. V. BOYS. Dated June 3.

2482. "Improvements in magneto and dynamo-electric machines, or motors and means and methods for controlling their generative force." E. G. BREWER. (Communicated by T. A. Edison.) Dated June 7.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1880.

3765. "Electric lamps, &c." E. G. BREWER. (A communication from abroad by Thomas Alva Edison, of Menlo Park.) Dated September 16. 1s. 2d. Relates to the well-known Edison incandescent lamp.

3885. "Telephonic apparatus, &c." WILLIAM MORGAN-BROWN. (A communication from abroad by Alexander Graham Bell.) Dated September 25. 1s. 4d. Relates to Professor Bell's photophonic discoveries, all of which are covered by the patent.

3894. "Electro-magnetic railroads, &c." PETER JENSEN. (A communication from abroad by Thomas Alva Edison, of Menlo Park.) Dated September 25. 1s. 6d. The invention consists in a complete electro-magnetic railway system, embracing the generation, distribution, and utilisation of electric currents as a motive power, and in the novel device and combination of devices for effecting the same.

3925. "Lightning conductors." SAMUEL VYLE. Dated September 28. 6d. Relates to the construction, &c., of lightning conductors, as described on page 233 of this Journal.

3964. "Magneto-electric machines, &c." PETER JENSEN. (A communication from abroad by Thomas Alva Edison, of Menlo Park.) Dated September 30. 10d. A portion of the invention relates to the commutator brushes, of which there are several, so that the wear is distributed, and one can be replaced at a time while the machine is running, so that a breakdown is avoided. Another portion of the invention relates to the combination of the prime motor directly with the magneto or dynamo-electric machine, instead of through the medium of belts.

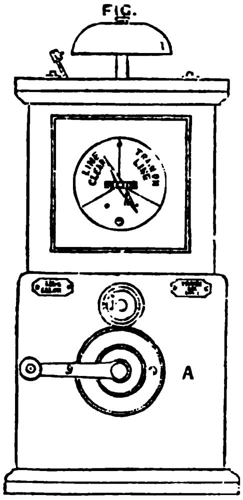
3971. "Dynamo-electric machines, &c." A. M. CLARK. (A communication from abroad by Alfred Niaudet and Emile Reynier.) Dated September 30. 10d. Relates to improvements in the magneto-electric machine described in the TELEGRAPHIC JOURNAL for April 1st, 1876. (*Provisional only.*)

4005. "Electric machines." E. G. BREWER. (A communication from abroad by Alexis Jean Baptiste Cance, of Paris.) Dated October 2. 6d. Relates to the dynamo-electric machine described in the TELEGRAPHIC JOURNAL for October 15th.

4007. "Magneto-electric apparatus for railway signalling." GEMINIANO ZANNI. Dated October 2. 6d. The object of this invention is to provide means whereby magneto-electric currents may be successfully utilised for signalling on railways. Fig. 1 is a front

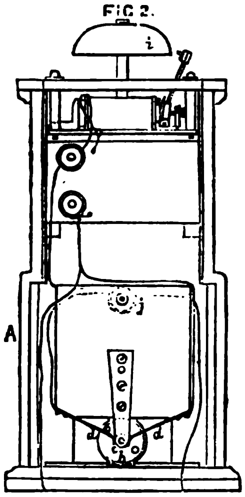
elevation of the improved railway signalling apparatus; fig. 2 is a rear elevation of the same with the back of the case removed, and fig. 3 is a front elevation of the apparatus with the front of the case and the needle-dial removed, and fig. 4 is an end elevation of the said apparatus with part of the case removed. The current for working the apparatus is produced by a single or permanent compound magnet, *a*, of the ordinary

FIG.



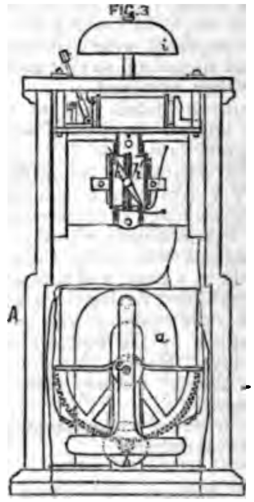
horse-shoe form, and a revolving armature, *b*, whose spindle or axis carries a disc or cylinder, *c*, upon which the springs, *d*, *d*, rest. To impart the requisite rotary motion to the armature there is arranged upon a shaft, *e*, a toothed segment or rack, *f*, which gears

FIG 2.



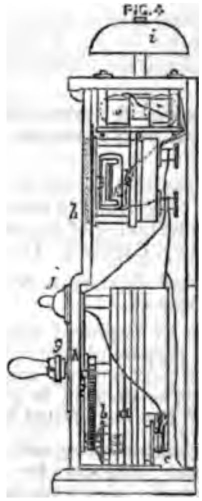
with a pinion on the spindle of the said armature. This segment has a to-and-fro motion imparted to it by the handle, *g*, attached to the shaft, *e*, on the outside of the case, A, as shown in figs. 1 and 4. Upon the dial of an indicator a needle hand or index, *h*, moves to and fro; this needle is supported upon *an axis* or spindle, h^1, provided with a polarised *magnet*, h^2, *so that the needle* can be caused to rock by changing the polarity of the magnetic current passing through the line-wire, this change of polarity being produced by turning the handle, *g*, in opposite directions. The needle or index will thus indicate "line clear" or "train on line." The apparatus is provided with an electric bell, *i*, in the same circuit as the coil of the needle, *h*. The switch, *j*, allows the indicator and bell to be cut out of

FIG. 3



the circuit when the apparatus is to be used as a sending instrument. When it is desired to give a signal the electric bell and indicator at the sending station are cut out of the circuit by pushing in the switch, *j*. Whilst the switch button is thus pressed

FIG. 4



inward, the crank or handle, *g*, is turned and rotates the armature, *b*, in the field of the permanent magnet, *a*, thereby producing a strong and continuous magnetic current which, passing through the coils surrounding the magnet, h^2, on the needle-spindle, h^1, at the receiving station, causes the said magnet and the needle to rock in one or the other direction according to the polarity of the magnetic current generated, and

or being suitably arranged for the purpose, ıd signal will be given. As soon as the given and the switch, j, is released, the current will differ in polarity, that is to say, itive or negative, according to the direction he crank, g, is rotated. To prevent any displacement of the needle after it has been ither to "line clear" or "train on line," lly extending arm of the magnet, h^2, is made weight than the lower arm, so that when the is caused to pass to either side of a vertical h the axis of the needle by the passage of a current through the line wire and the coils, ill hold the needle in position until a reverse sent through the said line wire. It is to change the position of the needle at the tation if at the sending station the crank or should be moved accidentally or by ce on the part of the operator (without the switch) from the position to which it urned, and should be again moved in the tion as that required to effect the last ad- f the needle; in such a case the ringing of all that will be effected at the receiving a reversal of the polarity of the current before there can be any readjustment of the

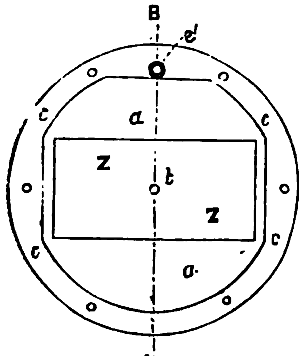
lectrical signalling and indicating apparatus." E. (A communication from abroad by Francis America.) Dated October 11. 6d. Relates al signalling and indicating apparatus for or telegraphic purposes, and comprises the ıt of a number of synchronously-revolving r the control of a battery current upon a uit, but acting automatically, each at a ime, to ring a magneto-bell by diverting putting to earth through the magneto-bell -current generated at the central office, in n with a device, under the control of the t the central office, by which the automatic of the dial at the central office may be made with the automatic operation of the dial at he out stations. It also comprises a device g when the line is in use.

Electric lamps for locomotive engines." PALMER HARDING. Dated October 15. 4d. the lighting or signal lamps for locomotive nd consists in the application of the electric place or as an addition to the ordinary signal ısed on the fore part of the engine. The achine for producing the electric current is ked by the locomotive machinery or by an ngine attached to the locomotive frame.

'Galvanic batteries." R. C. ANDERSON. tober 20. 4d. Relates to improvements c batteries, the object of the improvements rovide a battery which shall be both powerful ant without necessitating the employment sent) of free mineral acid in the negative whereby the emission of acid vapours and wasteful action of such acids on the zinc f the battery are avoided. The zinc is n preferably by a solution of chloride of n. The negative element (carbon) is im- a saturated solution of chromo-chloride of

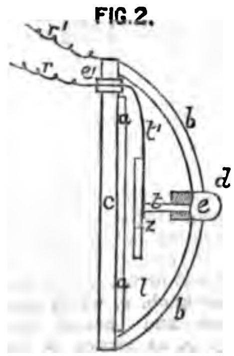
'Electrical apparatus for operating bells, nd telegraphs." GREGOIRE SKRIVANOFF. ober 25. 6d. The object of this invention duce a simple and efficient apparatus for bells, signals, and telegraphs by electricity. vertical section of the apparatus. Fig. 2 is a cross-section of the same on the line, A, B, fig. 1 Fig. 3 is a similar cross-section, without the external cover, showing the apparatus when at rest. Fig. 4 is a similar cross-section, showing the apparatus when in motion. b is a cover made of ebonite. c is a disc of retort charcoal. This disc, c, is fitted within the cover, b, and secured to the wall in any convenient way. The inner surface of this disc, c, is partially faced, as shown, with a layer, a, of asbestos. This facing is caused to adhere to the charcoal disc by means of a small quantity of paraffin at the upper part of the disc. The asbestos layer is covered with blotting-paper impregnated with a concentrated solution of chloride of zinc with a few drops of sulphuric acid. A plate of zinc, z, is placed parallel with the face of the layer, a, at a slight distance therefrom, and is soldered to one end of the

FIG. I.



copper rod, t, the other end of which rod passes through the spiral spring, d, and is attached to the knob, e. This knob, e, rests upon the spring, d, within a circular recess, see fig. 2. Near the edge of the disc, c, is formed a small circular hole, through which is passed a small split tube of copper, at one

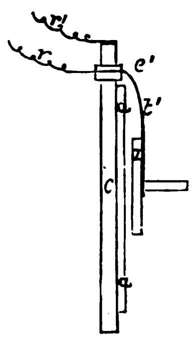
FIG. 2.



end of which tube a long tongue of copper is left; this split tube of copper is kept in place by a small hollow cylinder of ebonite, e^1, or of other suitable material fitted within such tube so as to press the latter against the charcoal by expanding it. The said tongue of copper is passed from the interior to the exterior of the case over the edge of the carbon disc. See figs. 2, 3, and 4. To the free end of this tongue the negative wire, r, is attached. To the copper rod, t,

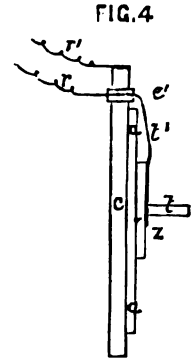
is attached a strip or tongue of copper, t^1, to which is secured the electro-positive wire, r, which passes through the said hollow cylinder, e^1. These conducting wires are continued to the bell or other signal to be operated and applied thereto in the usual way for effecting electrical action. The electro-positive metal must be carefully varnished on the surface bearing the conducting appendage. Before uniting the disc, c, to the cover, b, there is introduced into the lower part of the case at l, as a reserve, a quantity of crystals of

FIG. 3.



chloro-chromate of potass, coarsely broken, and moistened by a small quantity of the exciting liquid. These crystals must not touch the zinc. When the apparatus thus described is put together, as shown in fig. 2, the lower portion below the metal plate, s, forms

FIG. 4



the reservoir for the exciting liquid, l, which, for zinc, consists of a concentrated solution of chloro-chromate of potass strengthened by an eighth part thereof of sulphuric acid. In operating the apparatus, which is shown when at rest in fig. 3, it is only necessary to press inwards the knob, e, which pushes the metal plate, s, in close and parallel contact with the moistened facing, a, as shown in fig. 4, when an electric current is instantly produced, and the distant signal thereby operated.

The following are the final quotations of telegraphs for the 13th inst.:—Anglo-American, Limited, 55-55½; Ditto, Preferred, 86-87; Ditto, Deferred, 27-27½; Black Sea, Limited, ——; Brazilian Submarine, Limited, 10¾-11; *Brush Light*, 4¼-4½ prem.; Electric Light, ¼-½ prem.; *Consolidated Telephone Construction*, ¼-½ prem.; Cuba, Limited, 9½-10; Cuba, Limited, 10 per cent. Preference, 16¾-17¼; Direct Spanish, Limited, 3¾-4¼; Direct Spanish, 10 per cent. Preference, 13½-14½; Direct United States Cable, Limited, 1877, 10⅞-11⅛; Debentures, 1884, 103-105; Eastern Limited, 10½-10¾; Eastern 6 per cent. Preference, 12⅞-13⅛; Eastern, 6 per cent. Debentures, repayable October, 1883, 103-106; Eastern 5 per cent. Debentures, repayable August, 1887, 103-106; Eastern, 5 per cent., repayable Aug., 1899, 107-110; Eastern Extension, Australasian and China, Limited, 11⅛-11⅜; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 109-112; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 106-109; Ditto, registered, repayable 1900, 106-109; Ditto, 5 per cent. Debenture, 1890, 103-106; Eastern and South African, Limited, 5 per cent. Mortgage Debentures, redeemable 1900, 106-109; Ditto, ditto, to bearer, 105-108; German Union Telegraph and Trust, 11½-12; Globe Telegraph and Trust, Limited, 6¼-6½; Globe, 6 per cent. Preference, 12½-12¾; Great Northern, 13-13¼; 5 per cent. Debentures, 103-106; Indo-European, Limited, 28-29; London Platino-Brazilian, Limited, 5⅞-6⅛; Mediterranean Extension, Limited, 2¼-2¾; Mediterranean Extension, 8 per cent. Preference, 9¾-10¼; Oriental Telephone, ⅜-⅝; Reuter's Limited, 11-12; Submarine, 270-290; Submarine Scrip, 2⅛-2⅜; Submarine Cables Trust, 103-106; West Coast of America, Limited, 4¼-4¾; West India and Panama, Limited, 2¼-2½; Ditto, 6 per cent. First Preference, 7½-8; Ditto, ditto, Second Preference, 6¾-7¼; Western and Brazilian, Limited, 8-8½; Ditto, 6 per cent. Debentures "A," 108-110; Ditto, ditto, ditto, "B," 98-102; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 123-128; Ditto, 6 per cent. Sterling Bonds, 106-110; Telegraph Construction and Maintenance, Limited, 32-32½; Ditto, 6 per cent. Bonds, 106-110; Ditto, Second Bonus Trust Certificates, 3⅞-4⅛; India Rubber Company, 21-22; Ditto, 6 per cent. Debenture, 107-110; United Telephone, 8¼-8½.

TRAFFIC RECEIPTS.

NAME OF COMPANY.		APRIL.	MAY.	REMARKS.
		£	£	
Anglo-American...	1881 *1880*	43,980 *41,540*	49,880 *41,970*	
Brazilian S'marine	1881 *1880*	15,538 *15,525*	13,607 *10,321*	
Cie. Française ...	1881 *1880*	... ..	... ..	Not published.
Cuba Submarine...	1881 *1880*	3,100 *3,130*	3,000 *2,972*	March receipts realised £3,124.
Direct Spanish ...	1881 *1880*	1,337 *1,453*	1,547 *1,334*	
Direct U. States ...	1881 *1880*	14,660 ..	13,990 *16,630*	At 2s per word.
Eastern	1881 *1880*	45,289 *44,745*	43,872 *42,953*	
Eastern Extension	1881 *1880*	26,746 *24,342*	29,523 *26,570*	
Great Northern ...	1881 *1880*	17,720 *18,360*	21,600 *19,480*	
Indo-European ...	1881 *1880*	... ..	... ..	Not published.
Submarine	1881 *1880*	... ..	... ..	Publication temporarily suspended.
W. Coast America	1881 *1880*	... ..	... ..	
West. & Brazilian	1881 *1880*	10,484 *11,302*	9,249 *7,797*	
West India	1881 *1880*	5,470 *4,536*	5,560 *3,775*	

THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. IX.—No. 202.

THE PATENTS FOR INVENTIONS BILL.

ALTHOUGH Mr. Anderson's Bill for amending the existing law relating to Patents has been read a second time, it seems to be certain that it will not become law during the present session; the matter however cannot long remain unsettled, as the pressure which has been brought to bear is not likely to be diminished. In the debate which followed Mr. Anderson's motion there was a very general concurrence of opinion that the laws required alteration, though what the alteration should be was practically left an open question. To reduce the fees and to lengthen the period during which a patent is good, are of course the two main elements required, and in these two respects England stands at a great disadvantage as compared with America, and indeed with European countries. The fact that charges to patentees in Germany, France, Austria, and Belgium, are less than in England, might however be taken as an argument against the proposed reduction of the fees, for we are not aware that invention in the countries mentioned is so remarkably ahead of our own country; this fact appears to have been quite overlooked, as it was with America, and America only, that comparisons were made in the debate. It appears that the cost of a patent in America is 35 dollars for 17 years' protection, and in this country the cost is as much as 875 dollars for 14 years, so that we are charged 25 times as much as the Americans for a less valuable privilege. The United States Government does not seek to make a profit out of patents, but only to pay the expenses of the Patent Office. Their more liberal system, however, under which 15,000 patents were taken out in a year, as against 3,300 in Great Britain, pays so well as to leave a considerable surplus to the credit of the Patent Office, and the Government is considering the reduction of the charge of £7 to a still lower figure.

One of the most beneficial improvements suggested by Mr. Anderson is the proposal to extend the term of the provisional patent from six months to twelve; the former period is certainly, in the majority of cases, barely sufficient to enable an inventor to place his invention in the market. But it is doubtful whether it is advisable to divide the term during which a patent may be made good into various periods. Mr. Anderson, in making suggestions for changing the existing state of affairs, brought forward no argument to prove that it was desirable to retain the present system of dividing the full term into periods, nor in the debate was anything said either for or against the arrangement. If the reform is undertaken, it is to be hoped that as simple and cheap a system as that adopted in America will be framed, and there is, we think, little likelihood that such a system will require an increase in taxation to enable the Patent Office to carry on the necessary work.

FULLER'S IMPROVED MIRROR SIGNALLING GALVANOMETER.

THE object of this arrangement, the invention of Mr. J. W. Fuller, is to obtain a clearer definition of signals on the mirror instrument than is possible with the existing apparatus, and at the same time to make these signals as rapid and distinct as possible, so as to obtain a high speed of working. In order to effect these results, the bobbin on which the insulated wire is wound is constructed of a peculiar shape, the opening or passage throughout its centre being of various dimensions, diminishing as it approaches the part to be occupied by the mirror; the consequence is that the conducting wire when wound upon it is at different distances from the centre, according to the position in which it surrounds the before-mentioned opening.

At the end of the central opening or passage in the bobbin a special contrivance is inserted for holding the suspended mirror, consisting of a semi-funnel-shaped tube or cup, and made so as to suit whatever range of reflected light may be required upon the scale.

Fig. 1 is a transverse section of the bobbin and coils of the improved instrument. It is wound in four sections, *a*, *b*, *c*, and *d*. The front coil, section *a*, *w*, *a*, has an opening in the centre of a size only sufficient to receive the holder, in which the suspended mirror and magnet are contained. This holder is shown by the fig. 2, the mirror and magnet being arranged and suspended in the usual manner. The part of the holder in which the mirror and magnet are held suspended is of cylindrical form, and from this two wings project obliquely to the front, giving to the holder a semi-funnel-like form. These wings, which from their obliquity do not obscure the light from the mirror whilst it moves through a sufficiently large angle, render it easy to change the suspended magnet and mirror at any time when it may become desirable. The holder being taken hold of by its wings can be drawn out from its place in the centre of the part *a* of the coils, and put back in an instant.

The section, *b*, of the coils immediately behind the section, *a*, has an aperture through it larger than the aperture in the coil, *a*; and in the sections, *c* and *d*, the apertures are again and again larger. Thus there is a coniform cavity within the series of coils, and in this cavity are arranged adjusting appliances.

m represents the ordinary directing magnet above.

Fig. 3 shows a transverse section of the coils of the instrument, and with it one of the adjusting appliances. The latter consists of two straight

In making the adjustment these rods can be independently pushed inwards and drawn outwards with the fingers. They can also be moved together nearer to or further from the suspended mirror, for they are carried in a holder, *n*, which is coupled by

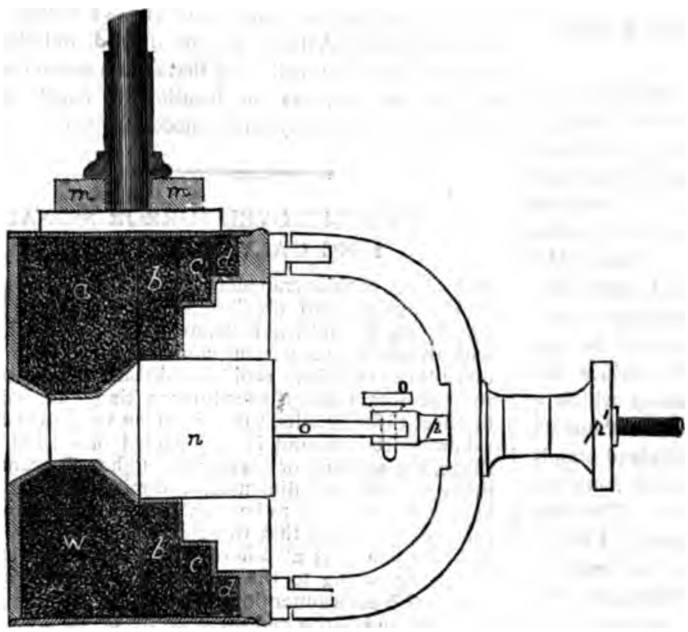


FIG. 1.

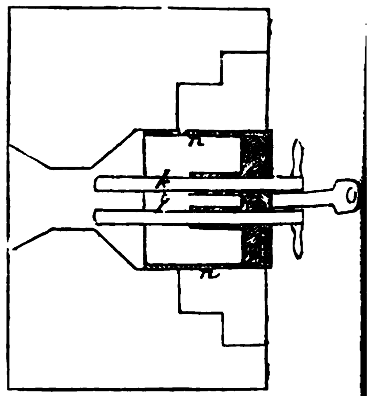


FIG. 3.

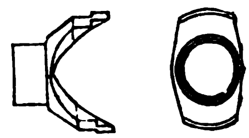


FIG. 2.

magnetic rods, *k* and *l*, joined across, the north pole of one to the south pole of the other, by the iron connecting piece, *m*; there are sockets on the connecting piece through which the magnetic rods, *k* and *l*, can slide.

the pin, *o*, with the slide, *p* (fig. 1). This slide has a screw cut upon its stem which passes through the thumb nut, p_1, and by turning this nut the slide, *p*, is moved to or from the coils carrying the adjusting appliance with it.

NEW ELECTRIC LAMPS.

THE GRAMME ARC LAMP.

By HYPPOLYTE FONTAINE.

AFTER three months of experiments with a score of lamps, we have come to the conclusion that the last idea of M. Gramme has solved completely the problem of fixity in powerful electric lamps.

The Gramme regulator, represented in elevation by the figure, is arranged to show in the same plan the important parts of the mechanism.

In this apparatus the lower carbon holder is fixed, the upper one is movable. These conditions are not indispensable. M. Gramme makes regulators with the luminous point fixed, placed in position without any screen, and arranged to throw all their light on the ceiling, &c. All the special forms possess the same essential parts in the mechanism, viz., a very powerful motor, an intermittent electro-magnet, a withdrawing movement distinct from the approaching movement, a carbon holder with an eccentric spring.

The mechanism is contained in a cylindrical case fixed to two end discs solidly connected together by tie rods.

This mechanism is formed of two completely distinct parts, of which the one assures the progressive advancement of the carbons, and the other the recession for the formation of the voltaic arc.

The upper electro-magnet is attached to the tie pieces; its armature, C, is fixed to the upper part of the rods, E, E, which traverse the whole length of the

regulator, and are prolonged so as to form the lower carbon holder, G. Two springs, R, R, force the armature, C, away from the poles of the electro-magnet when no current is passing.

The current arrives by the positive terminal, which is in communication with the whole of the regulator; it passes by the positive central rod, D, through the upper carbon, the voltaic arc, the lower carbon, the negative rods, E, E, the electro-magnet, A, A, and leaves by the negative terminal, which is insulated.

What I am about to describe constitutes the retrograde movement for the formation of the arc. This movement is not only independent of the gearing mechanism, but it is also removed as far as possible from these. The inventor avoids thus the accidental influence which might take place between the two magnets.

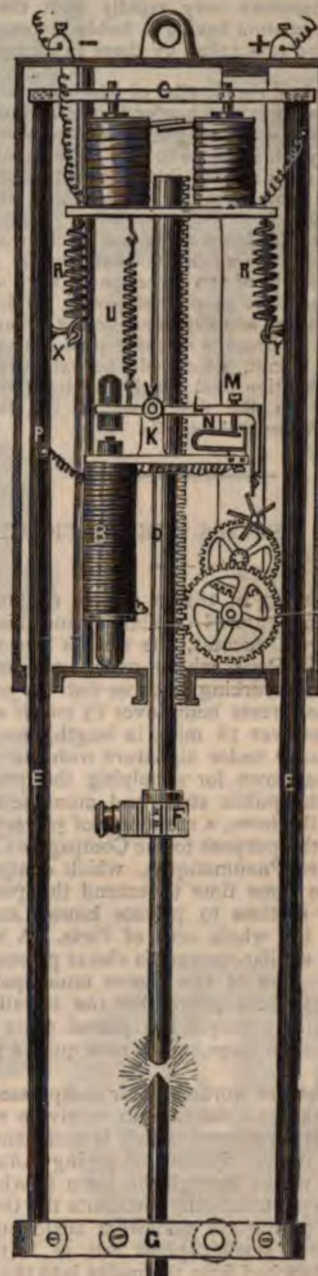
The positive rod, D, is very heavy; it is formed with a rack on one side, and carries at its extremity the upper carbon, F.

An electro-magnet, B, wound with a wire of high resistance, is fixed to the ties of the regulator. This electro-magnet carries a jointed piece, K, on which a lever, L, is hinged. This last is maintained in a horizontal position by the spring, U. The armature, I, of the electro-magnet, B, is fixed to the lever, L. A screw, M, and a little plate, S, are placed at the other extremity of the same lever. The mechanism is completed by a spring, N, insulated from the rest of the apparatus and placed on the piece, K, with a piece of hard rubber between.

The current which traverses the electro-magnet, B, comes from P through one of the negative rods, then, by means of a screw in communication with the spring, N, it passes through the latter to the screw, M, and the lever, L. So long as the main current preserves a certain intensity—that is to say, so long as the voltaic arc does not become too long—the plate, S, locks the clockwork movement, and prevents the positive rod from descending. But at the moment when equilibrium is destroyed, the power of the electro-magnet, B, increases, the armature, I, is attracted, the lever oscillates, and the plate, S, becomes raised and allows the wheelwork and, consequently, the rod, D, to descend. The carbons approach and the arc becomes diminished in length. The screw, M, then leaves the spring, N, and the current ceases to traverse the electro-magnet, B. The armature, I, pulled by the spring, U, regains its horizontal position; the contact of the screw, M, with the spring, N, again takes place. And if the arc is not rigorously at its normal length, the same movement recommences until this result is obtained. The intermittence in the action of the electro-magnet, B, has a chief advantage in suppressing the variations of the light which is observable in all the other kinds of regulators.

This advantage is easy to explain. In all the regulators with a powerful motor the movement of approach of the carbons is obtained by the aid of an electro-magnet and a powerful antagonistic spring. When the influence of the electro-magnet makes itself felt—that is to say, when the armature is attracted—the distance between the poles and the armature becomes diminished, the equilibrium between the tension of the antagonistic spring and that of the electro-magnet becomes broken during a certain period. The carbons approach a little more than they ought and cause the arc to become too short before the wheelwork becomes locked. The variations of the arc take place naturally with the variations of the intensity of the current and the luminous arc changes correspondingly, as is so well known.

With an intermittent action of the electro-magnet the results are otherwise. As soon as equilibrium is destroyed between the antagonistic spring and the electro-magnet, the locking mechanism works and the carbons approach to a distance of several hundredths of a millimetre; then, almost instantaneously, the



influence of the electro-magnet becomes completely annulled, the antagonistic spring pulls back the armature to its first position and causes a new break of equilibrium which causes a fresh unlocking. The sensibility of the apparatus is such that it works in a continuous

manner, exactly as if it were worked by automatic mechanism instead of being dependent on two balanced forces.

The choice of a powerful motor in the Gramme regulator explains itself. In a workshop or in every other place, sheltered or unsheltered, the dust and oxidisation interfere very rapidly with the proper working of regulators having a feeble motor, and this in spite of the care taken by those in charge of the apparatus.

On examining the details of the apparatus, and notably those parts which refer to the carbon holder and to the electro-magnet, we cannot but observe the care taken by M. Gramme to give to his regulator all the durable qualities possible, both as regards the solidity and good working which characterises his other inventions.

By means of this lamp and a new machine with flat electro-magnets, of which we shall shortly give an account, five lamps of 150 burner-power were obtained with an expenditure of 6 horse-power. MM. Sautter and Lemarnier are actually constructing, according to designs of M. Gramme, a machine producing 10 lights in the same circuit, which will be exhibited at the Electrical Exhibition, and which will light one of the great rooms on the first floor of the Palais de 'Industrie.—*Revue Industrielle.*

POPP AND RESCH'S PNEUMATIC CLOCKS.

AT the beginning of 1877 a system of pneumatic clocks was inaugurated in Vienna, and this having met with great success, the system has recently been tried in Paris, where over 2,000 of these clocks are now working in three districts only (the piping in the streets being over 15 miles, and that in the houses over 18 miles in length), and a contract is actually under signature with the municipality of that town for supplying the pneumatic time to all the public street and monument clocks throughout the town, a monopoly of 50 years being granted for the purpose to the Compagnie Générale des Horloges Pneumatiques, which company intends at the same time to extend the pneumatic distribution of time to private houses and firms throughout the whole area of Paris. A very important and similar contract is also at present under the consideration of the Vienna municipal authorities. These facts prove that the installation of the pneumatic principle has passed quite beyond the experimental stage, and is now quite a practical success.

The clocks are worked by air compressed at the central works and stored into receivers or reservoirs at a low pressure, which is sufficient for the work to be done. Systems of piping radiate from the central works through the town in which it is proposed to pneumatically distribute the time. The systems of piping are somewhat analogous to the gas piping, as smaller pipes are, as is the case with gas, branched from the mains into the houses, and branched again from the ascending branch pipes into rooms and apartments, &c.; but with this exception, that they are of much smaller dimensions altogether, the main pipes not exceeding one inch internal diameter. A main clock, which is accurately timed by means of a special contrivance, every minute opens a valve, which allows the compressed air to be discharged in the systems of piping. A very short time afterwards the same valve is shut, and the systems of piping put in communication with the atmosphere, by which the compressed air which they contain is discharged. This forward and backward motion of the compressed air, which is repeated automatically every minute, causes a bellows contained in each clock to correspondingly ascend and descend, the ascending motion forwarding, by means of a ratchet wheel, the hands of the clock one division, or one minute, at a time, the circumference of the ratchet wheel being divided into 60 divisions.

The mechanism for working each clock is shown by fig. 1, and it is, as can be seen, of the simplest character. The ratchet wheel is connected direct to the minute-hand and to the hour-hand by the usual gearing. The pawls, it will be seen, are maintained in their proper position by being weighted, so that they cannot well get wrong.

When it is desired to make the clock a striking one the movement of the ratchet lever winds up the striking mechanism.

The normal clock for regulating the pulsations of compressed air every minute is shown in general view by fig. 2. By means of mechanism somewhat similar to the striking mechanism of a clock an eccentric on one of the wheels of the train makes at a given time a half revolution, thus moving a valve and liberating the compressed air into the street mains. This valve is kept open for 20 seconds and then the eccentric makes another half revolution, which shuts the compressed air off and puts the street mains in communication with the atmosphere.

Fig. 3 is an elevation partly in section, and fig. 4 a horizontal section of a balanced side valve which effects the distribution of the compressed air.

This valve is constructed as follows:—The compressed air is admitted from the reservoir through the tube, P, into the valve chest, Q, by the orifice or inlet, R. The orifice or outlet through which the air passes from the valve chest into the system of pipes is shown at S, and an escape pipe for the same at T. When the slide valve, U, is in its normal position the outlet, S, and the exhaust-pipe, T, communicate, and the air in the conduit pipes of the system is at the same pressure as the atmosphere.

At the proper time the controlling clock actuates the rod of the valve by means of the connecting rod, V, and the lever, X, and the slide valve is thereby so operated that it uncovers the outlet, S, whilst covering the escape-pipe, T, but without covering the air-inlet, R. The compressed air then enters the outlet, S, penetrates into the conduit pipes, and actuates the clocks in the circuit. The slide valve then returns to its original position, the orifices, S and T, are put in communication, and the compressed air in the system escapes.

To diminish the friction of the slide valve upon its seat, the slide, U, is provided with a cylinder, U^1, in which a piston, U^2, works; upon its rod a roller, Y^1, is mounted, travelling upon a cross-bar, Z, firmly fixed in the interior of the valve chest; thus the friction of the slide upon its seat is to a great extent transformed into rolling friction by the action of the roller, Y^1, upon the cross-bar, Z. In practice the friction of the slide upon its seat will be found to be

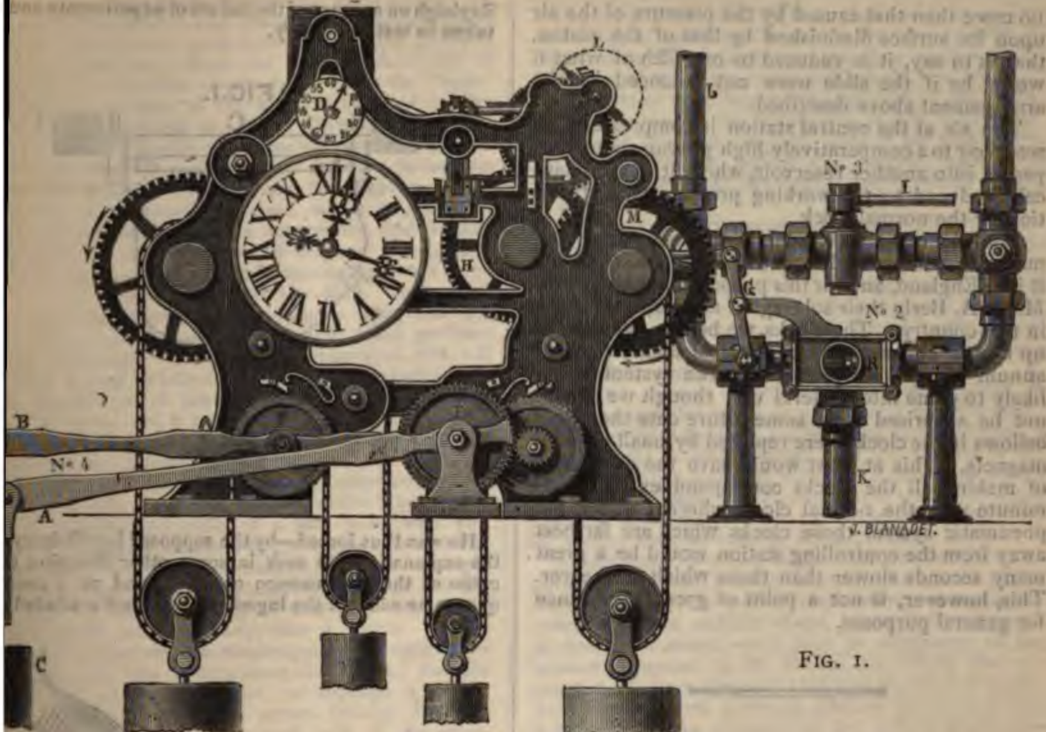


FIG. 1.

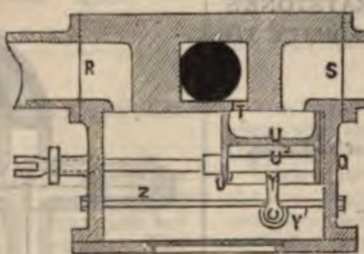
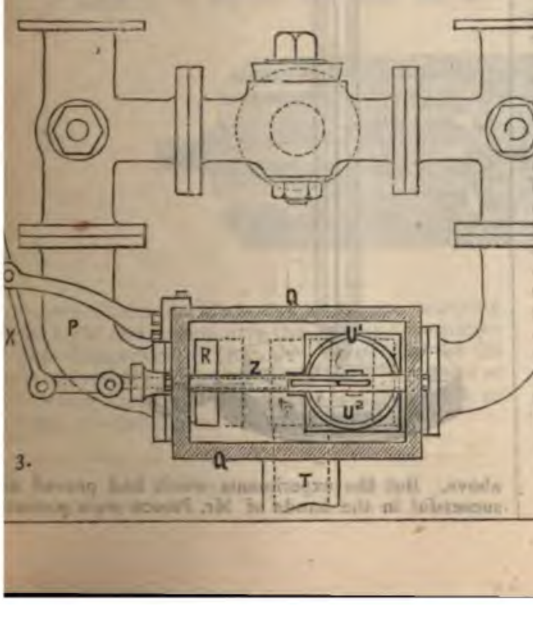


FIG. 4.



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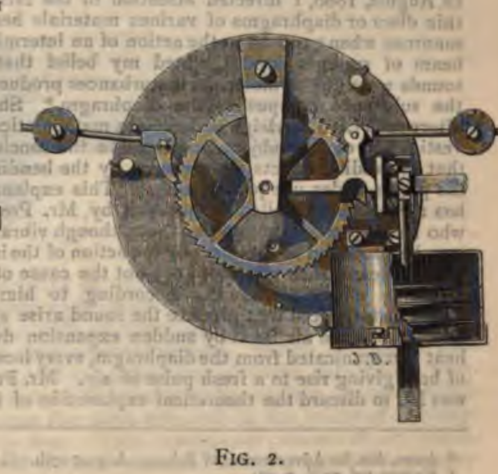


FIG. 2.

no more than that caused by the pressure of the air upon its surface diminished by that of the piston, that is to say, it is reduced to one-fifth of what it would be if the slide were not balanced by the arrangement above described.

The air at the central station is compressed in a reservoir to a comparatively high pressure, and then passes into another reservoir, where it is automatically reduced to the working pressure for distribution by the normal clock.

The Compagnie Générale des Horloges Pneumatiques, who work the system, purpose introducing it into England, and for this purpose have appointed Mr. J. A. Berly their sole agent and representative in this country. The clocks, we believe, will be put up free of expense, and a rental of about 15s. per annum charged for their use. The system seems likely to come into general use, though we should not be surprised if at some future date the small bellows in the clocks were replaced by small electromagnets. This at least would have the advantage of making all the clocks correspond exactly each minute with the normal clock, whereas under the pneumatic system those clocks which are farthest away from the controlling station would be a great many seconds slower than those which are nearer. This, however, is not a point of great importance for general purposes.

UPON A MODIFICATION OF WHEATSTONE'S MICROPHONE AND ITS APPLICABILITY TO RADIOPHONIC RESEARCHES.

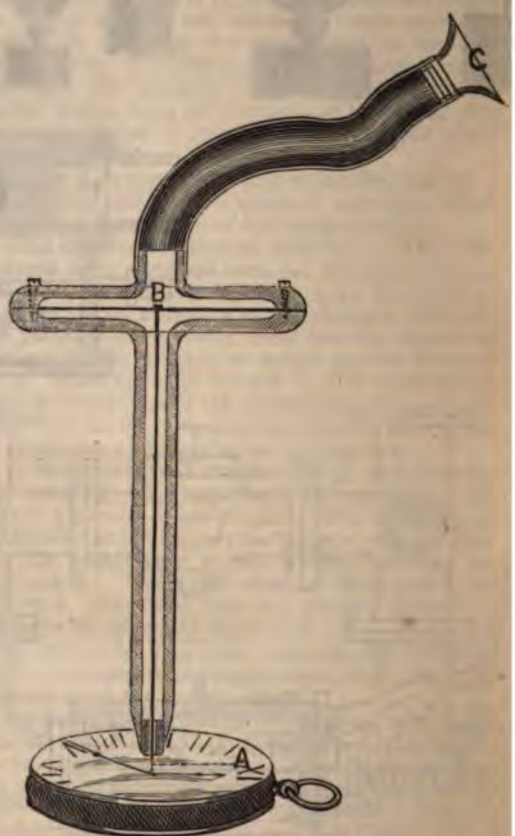
A Paper read before the Philosophical Society of Washington, D. C., June 11th, 1881,

By ALEX. GRAHAM BELL.

IN August, 1880, I directed attention to the fact that thin discs or diaphragms of various materials become sonorous when exposed to the action of an intermittent beam of sunlight, and I stated my belief that the sounds were due to molecular disturbances produced in the substance composing the diaphragm.* Shortly afterwards Lord Rayleigh undertook a mathematical investigation of the subject, and came to the conclusion that the audible effects were caused by the bending of the plates under unequal heating.† This explanation has recently been called in question by Mr. Preece,‡ who has expressed the opinion that although vibrations may be produced in the discs by the action of the intermittent beam, such vibrations are not the cause of the sonorous effects observed. According to him the aerial disturbances that produce the sound arise spontaneously in the air itself by sudden expansion due to heat communicated from the diaphragm, every increase of heat giving rise to a fresh pulse of air. Mr. Preece was led to discard the theoretical explanation of Lord Rayleigh on account of the failure of experiments undertaken to test the theory.

FIG. I.

He was thus forced—by the supposed insufficiency of the explanation—to seek in some other direction the cause of the phenomenon observed, and as a consequence he adopted the ingenious hypothesis alluded to



above. But the experiments which had proved unsuccessful in the hands of Mr. Preece were perfectly

* Amer. Ass. for Advancement of Science, August 27th, 1880.
† *Nature*, vol. xxiii., p. 274.
‡ *Roy. Soc., March 10th, 1881.*

successful when repeated in America under better conditions of experiment, and the supposed necessity for another hypothesis at once vanished. I have shown in a recent paper read before the National Academy of Science* that audible sounds result from the expansion and contraction of the material exposed to the beam; and that a real to and fro vibration of the diaphragm occurs capable of producing sonorous effects. It has occurred to me that Mr. Preece's failure to detect with a delicate microphone the sonorous vibrations that were so easily observed in our experiments might be explained upon the supposition that he had employed the ordinary form of Hughes' microphone shown in fig. 1, and that the vibrating area was confined to the central portion of the disc. Under such circumstances it might easily happen that both the supports, *a b*, of the microphone might touch portions of the diaphragm which were practically at rest. It would of course be interesting to ascertain whether any such localisation of the vibration as that supposed really occurred, and I have great pleasure in showing to you to-night the apparatus by means of which this point has been investigated (*see* fig. 2).

The instrument is a modification of the form of microphone devised in 1827 by the late Sir Charles Wheatstone, and it consists essentially of a stiff wire, one end of which is rigidly attached to the centre of a metallic diaphragm, B. In Wheatstone's original arrangement the diaphragm was placed directly against the ear, and the free extremity of the wire was rested against some sounding body, like a watch. In the present arrangement the diaphragm is clamped at the circumference like a telephone-diaphragm, and the sounds are conveyed to the ear through a rubber hearing-tube, C. The wire passes through the perforated handle, and is exposed only at the extremity. When the point was rested against the centre of a diaphragm upon which was focussed an intermittent beam of sunlight, a clear musical tone was perceived by applying the ear to the hearing-tube, C. The surface of the diaphragm was then explored with the point of the microphone, and sounds were obtained in all parts of the illuminated area and in the corresponding area on the other side of the diaphragm. Outside of this area, on both sides of the diaphragm, the sounds became weaker and weaker, until at a certain distance from the centre they could no longer be perceived.

At the points where one would naturally place the supports of a Hughes' microphone (*see* fig. 1) no sound was observed. We were also unable to detect any audible effects when the point of the microphone was rested against the support to which the diaphragm was attached. The negative results obtained in Europe by Mr. Preece may therefore be reconciled with the positive results obtained in America by Mr. Tainter and myself. A still more curious demonstration of localisation of vibration occurred in the case of a large metallic mass. An intermittent beam of sunlight was focussed upon a brass weight (1 kilogramme), and the surface of the weight was then explored with the microphone shown in fig. 2. A feeble but distinct sound was heard upon touching the surface within the illuminated area and for a short distance outside, but not in other parts

In this experiment, as in the case of the thin diaphragm, absolute contact between the point of the microphone and the surface explored was necessary in order to obtain audible effects. Now, I do not mean to deny that sound-waves may be originated in the manner suggested by Mr. Preece, but I think that our experiments have demonstrated that the kind of action described by Lord Rayleigh actually occurs, and that it is sufficient to account for the audible effects observed.

* April 21, 1881.

THE WESTON ELECTRIC LIGHT SYSTEM.

THE Weston Electric Light system, which has recently been introduced into this country, claims to produce the electric light more practically and economically than any known system. The light is stated to be entirely free from the disagreeable blue and violet rays which are so trying to the sight and which give the ghastly appearance to the complexion. The arc is peculiar for its great steadiness, being maintained at the point of the carbon, instead of moving from side to side, as in other divided lights.

The Weston machine runs at a comparatively low speed with light belts, and is very free from sparking at the brushes.

While there are some points of resemblance in the construction of the various light machines, the armature used in the Weston machine differs from any other form in use.

This armature, which is shown by the figure, is constructed of sectional plates of metal, with space between each, in such a manner as to be opposite similar slits or openings in the inductors of the large iron electro-magnets. When in motion the current of air passes out of these slits, being propelled from the centre to the surface by centrifugal force on the same principle as the action of a rotary fan blower. This continuous current of air, taken in cool at the centre, and blowing out at the circum-

ference, is most effectual in keeping the machine cool.

In the Weston lamp the lower carbon is fixed, and the upper one is suspended from a rod which is capable of sliding freely up and down, but whose motion is regulated by small clamps worked by an electro-magnet. When the magnet is excited, its attraction closes the clamps and draws the carbon up. When the current becomes weakened, the clamps relax, and allow the carbon to slide down. The carbons employed in the lamps are claimed to be of very high quality, so that they burn with great steadiness.

During the last week an exhibition of the Weston apparatus has been held at the Albany Works, Euston Road, by the exhibitors of the Maxim light. Ten lamps were driven from one machine, and all burned with great regularity and steadiness.

A very large number of the machines and lamps are being imported into this country. The larger machines will drive over 20 lights.

Notes.

ELECTRIC FIRE ALARM.—By M. A. Ledien.—This instrument consists of a piece of wood connected to the wires of a constant battery, such as that of Daniell, by means of strong copper screws sunk up to the head. This piece of wood is kept always slightly moist by being wrapped in some porous material, communicating by means of filaments of the same substance with a vessel of water. It is placed in the interior of the powder magazine, or other store, whose temperature it is necessary to watch. The battery is outside, and a very sensitive galvanometer is introduced into the circuit. This galvanometer indicates by the movements of its needle the variations in the dryness of the wood. It is placed fully in view, and the needle may be arranged so as to sound an electric alarm-bell on reaching zero.—*Comptes Rendus.*

CLOCKS WOUND-UP BY ELECTRICITY.—H. Füster, of Posen, has sent to the Electrotechnisch Verein the drawing of a clock which winds itself up by means of electricity.

JOSEPH ZIMBER, of Furtwanger, has solved the same problem, and his clock, described in the German patent, No. 12649, is arranged essentially in the same manner as that of Füster.

DRS. VAN FEILITZSCH AND HOLTZ, of Greifswalde, have constructed an electro-magnet of uncommon size for the Physical Institute of the University of Greifswalde. The weight of the core is 628 kilos.; the number of layers of wire is 25, and the weight of the wire, 275 kilos.

DIVISION OF THE ELECTRIC LIGHT.—By Professor M. Avennarius.—The principle upon which the author bases the distribution of the electric light consists in making electric burners which derive their current from a source of electricity independent of each other. Suppose that in the circuit of a dynamo-electric machine four electric burners are introduced, I., II., III., and IV. In this, which has been hitherto the common connection of the lights, every fault of one of the lights, say I., occasions a weakening of the current, involving, of course, an enfeebled action of the remaining lights, II., III. and IV., which again reacts upon the current and upon the burning of No. I. A light which is perfectly constant, if introduced singly into a circuit, may, therefore, in the above case waver very perceptibly. But as all the lights of the circuit are exposed to the same conditions as I. the faults of all are reproduced in each, and regular burning is out of the question.

That only burners of equal strength can be introduced into such a circuit is self-evident. But if we suppose each light fitted with a lateral branch, 1, 2, 3 and 4, so that the current is divided before entering each of the lights, a part of it only passing the light and the rest the side-branch, we may conceive conditions which may make the lights so far independent of each other that their burning may be perfectly satisfactory. These conditions are:—

1. The current must chiefly pass through the light and not through the side-branch, in order not to occasion any loss of work by heating the latter.

2. Any weakening of the burning of a light (consequently an increase of the resistance) must cause a more easy passage of the current through the side-branch, so that even the extinction of light I. may involve no appreciable change in the burning of the others.

If we leave regulators out of consideration, only three kinds of conductors are possible:—

1. If conductors of the first class are used, *i.e.*, metallic wires, those which answer the first condition will not fulfil the second, and conversely.

2. If non-conductors are used, *i. e.*, condensers, their capacity must be very great. When using varnished silk or tin-foil, Avennarius found that a condenser-surface of 20 square metres was too small to keep up the current. Jablochkoff succeeded with a condenser of 200 square metres. But on considering the expense which such a condenser involves, and the changes which the varnish suffers from time and from the action of the current, the hope of solving the problem in this manner must be abandoned.

3. The question may be solved by the use of conductors of the second class, *i.e.*, liquids.

Suppose we have a voltameter, *e.g.*, platinum in water acidified with sulphuric acid. As is well known, a current will not pass through unless the electromotor force of the battery equals two Daniell's elements. If we connect n voltameters to form an apparatus, which we may name a polariser, the electromotive force must $= 2n$ Daniells in order that the current may traverse this polarisator. If we have to do with alternating currents (such as are used for Jablochkoff candles), we can divide the time during which the stream retains a constant direction into two parts. In the first the electromotor force of the machine does not reach $2n$ Daniells, and the entire current passes through the light; in the second, where it exceeds $2n$ Daniells, the current is divided according to known laws. It is easy to arrange the polarisation and the resistance of the apparatus so as to fulfil conditions 1 and 2. As concerns the decomposition of the liquid in the polariser, the gases which are evolved during one direction of the current recombine when it takes the opposite direction, and no decomposition of the liquid is experienced. Hence, consequently, there is no expenditure of work to be feared in this direction. The most important result obtained is the mutual independence of the lights. Hence follows:—

1. The number of the lights can be considerably increased.

2. Lights of different strength can be introduced into one and the same circuit.

3. If one of the plates of the polariser is movable, its resistance can be varied, and the corresponding light can be made to burn more strongly or more feebly at pleasure.—*Zeitschrift für Angewandte Electricitätslehre.*

ON THE DISTRIBUTION OF THE ELECTRIC CURRENTS.—By M. Brillouin.—The author considers a wire connected at its ends with a system of closed conductors, or with accumulators of such a size that the intensity of the current in the whole wire can be regarded as constant in any moment. The electromotor force in the wire, E, results from the formula :—

$$E = R\,i + \frac{d}{d\,t}\,(2\,w\,i + \Sigma\,W\,J) + \frac{d\,N}{d\,t} + V_B - V_A.$$

V_B and V_A are the variable electrostatic potentials at the end of the wire; R the resistance of the wire, w the electro dynamic potential; W the potential of the neighbouring wires upon the wire, d N, ($d\,t$ the work done at the unity) of the intensity in the wire of the permanent magnets from deformations of the wire and its relative changes of place.

He then considers a system of parallel wires whose ends are connected by the other unbranched wires of the circuit. He finds that the single streams do not in general follow Ohm's law. The latter comes into force only when the total energy of the intensity of the current in each wire has the same value at the end of the period as at the beginning. This is, *e.g.*, attained when the induction is elicited by the movement of magnets or currents situate outside the wires, or by a change of their intensity; or when single spirals in the branches of the currents revolve 360° round a diameter, or when all the spirals which have an inductive action upon each other revolve 180° without the action.—*Journal de Physique.*

ON AN EXPERIMENT OF PLUCKER'S.—By J. Moutier.—If a cylindrical magnet is placed in the middle of a magnetic bell, and if a point of the bell is connected by a wire with the upper end of the bell, a current passes through the wire if any one of the three parts of the magnet is moved. The electromotor force of the current is independent of the speed of the magnet, and depends merely on the relative speed of movement of the bell to the wire. Independently of any hypothesis on the nature of galvanic currents, Moutier considers that this phenomenon carrbe explained by the "electrotonic" state which is produced in the state of rest in the magnet, the bell, and the wire. On account of symmetry this condition remains unaltered when the magnet and the bell and the wire revolve together, but only when the relative positions of the parts of the system are charged by a movement of the bell or the wire.—*Bull. Soc. Philomath.*

ON THE ELECTRIC BEHAVIOUR OF FLAME.—By W. Holtz.—The author prefixes to his own experiments a general account of all researches on the electric behaviour of flame. His own experiments refer chiefly to the changes of the form and colour of flames when positively or negatively electrified. The flames are here so arranged that they form in a manner one of the electrodes of an influence machine. The positive flame becomes bluer, narrower, more pointed, whilst similar phenomena are scarcely perceptible in the negative flame. The latter displays, however, a curious phenomenon; its point is turned towards its own conductor. Hereby, according to the strength of the electrisation and the width of the aperture of the burner, an intermittent and a constant retrogression may be distinguished. The negative flame takes the most curious shape when it issues from a large disc, or when it burns round a metal cylinder. It is then bent backwards towards the metal surface, either in a curve or an angle, according to the strength of the electrisation. Its point in the latter case is divided into two tufts of a peculiar shape, which on their part make movements more or less similar.

Further differences result if a conducting body is held opposite to a flame which burns as an electrode. At a considerable distance each flame bends towards it; on approaching nearer there occurs a repulsion of the negative and an attraction of the positive flame. In the latter case the attraction extends only to the upper more luminous part, not to the foot of the flame which is still repelled. Herewith is connected the circumstance that a positive flame easily passes through wire gauze whilst the negative flame remains below. The pointed form of the positive flame is the cause that it readily drives a wheel with vanes, whilst the negative flame scarcely sets it in motion. All these and other distinctions appear especially in an unmixed gas flame, or in that of stearine, wax, or tallow, less in the flame of alcohol, and least in that of a Bunsen burner, being the less manifest the richer the flame in oxygen.

The phenomena in question are produced not merely on direct electrisation, but also when the flame is exposed to the influence action of a large disc. If a flame is introduced between two smaller electric discs, it inclines to the negative side, spreading itself out. With a certain strength of current it vibrates to and fro like a pendulum, and displays a peculiar stratification. These phenomena also occur the less the richer is the flame in oxygen. It is accordingly probable that carbon and hydrogen are attracted more to the negative, but oxygen more to the positive pole, perhaps—like every distinctively polar attraction—in consequence of a certain uni-polar conductivity of the substance in question. The retrogression of the flame is thus explained: the point of the flame loses more electricity by influence than it receives by conduction. A strip of paper, one end of which is pasted to a large ball, displays similar movements as soon as the free end is pointed and made more conductive. There are two causes why the negative becomes retrograde. Either the point of the flame has here an exceptional radiating power, or the foot of the flame is here an exceptionally bad conductor. The former supposition agrees with the experiments of Wiedemann and Rühlmann, and the latter with Erm an's observation on the uni-polar conduction of flames. Other grounds speak in favour of the existence of an uni-polar conduction. The resistance observed by Hittorf at the negative electrode cannot explain Erman's experiments, since if negative electricity penetrates into the flame with more difficulty, positive electricity must have more difficulty in making its exit.

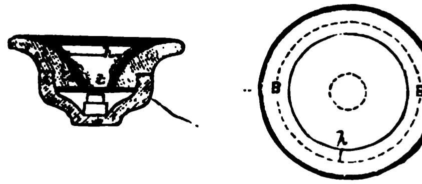
Herwig's explanation of the above resistance by the assumption of a negative specific electricity does not agree with the fact that the flame is drawn exactly to the negative pole. It may otherwise be concluded that the specific electricity of flame can play no essential part in the phenomena above mentioned.—*Wiedemann's Beiblätter.*

THE Earl of Crawford and Balcarres, F.R.S., has been appointed British Commissioner to watch over British interests at the forthcoming electrical exhibition at Paris. The appointment of his lordship, who is better known as Lord Lindsay, has been received with great approval. The exhibition will open on August 1st without fail.

M. PLANTÉ is about to establish a factory for the manufacture of his secondary batteries. He contends

that his form is in reality better than M. Faure's modification, as the latter cannot be charged except by a battery, whereas the simple lead-plates can be worked by a magneto-electric machine.

• A TELEPHONE has recently been patented (Patent No. 242,156, filed Jan. 29th, 1881) by Mr. C. W.

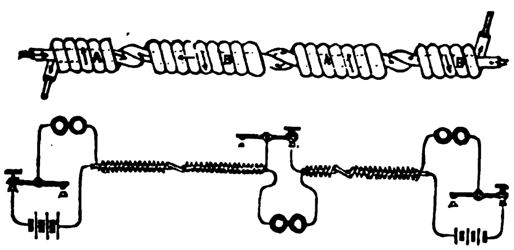


Raymond, of New York. In this telephone, which is shown by the figure, there is a supplemental diaphragm which covers the mouthpiece.

THE whole of the text of the revised version of the New Testament was transmitted from New York to Chicago on the evening of May 20th. It consisted of 110,000 words, and was started on four wires at 5.30 p.m. At 6 p.m. eight wires were used; at 7.30 p.m. sixteen wires, and at 8.45 p.m. twenty wires. It was finished at 12.20 a.m.

LLOYD'S Committee have made application to the Clyde Lighthouses Trust for accommodation at Cumbrae for an operator to work a telegraph signalling station there. The request has been granted by the Trust, so that there is now every prospect of having telegraphic communication from that quarter very soon. Lloyd's Committee are also making inquiry as to which would be the best point in the North Channel—Tory, Innistrahul, or Rathlin—for establishing another signalling station, and the same committee have further in view the propriety of establishing a signalling station at Pladda or on the Holy Isle.

A PATENT (No. 242,343, filed April 16th, 1881) has been taken out in America by Orazio Lugo for a telegraph circuit consisting, as shown, of an electric



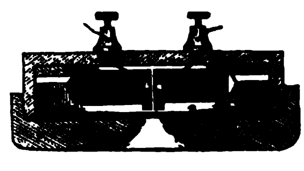
conductor formed of two or more solenoids connected together in series, and having the helical conductor of each solenoid joined to the axial conductor of the next solenoid in series in each direction, and *vice versâ*.

A RECENT observation by Herr Holtz throws some light on the question as to the penetration of electricity into the mass of an insulating plate. He held an ebonite disc of 1½ mm. between the pointed discharge-rods of a Holtz machine, then laid the charged disc on a table (being diverted from an experiment of another kind he had intended). In about a quarter of a minute he heard a weak discharge, and found the disc broken. He repeated the effect with another disc. Considering (he says) that the charge of the plate, after this was left to itself, could not possibly have been strengthened, but must have diminished rather, the result proves unmistakably that the opposite electricities must come next one another. The effect was not obtainable with glass discs.

A TRAMCAR has been driven in Paris by means of Faure's accumulators. It conveyed forty persons at the rate of six miles an hour, the motive power being 160 Faure batteries, weighing 18lb. each, altogether 2,880lb.

DURING the past four years the overhead wires in London have been reduced from 1,720 miles to 500, and the underground work increased from 3,350 to 4,388. There has thus been a reduction of 1,220 miles in the overhead work, and an increase of 1,038 miles in the underground work, so that the total mileage of line has been reduced; this is due, however, to a better arrangement of the circuits.

THE telephone shown by the figure has been patented (No. 242,204, filed Dec. 17th, 1881) in America by Mr. C. A. Hussey. It consists of a diaphragm, a per-



manent magnet of continuous or endless form provided with poles or consequent points, one or more of which extend towards the centre of the diaphragm, and which are wound with wire.

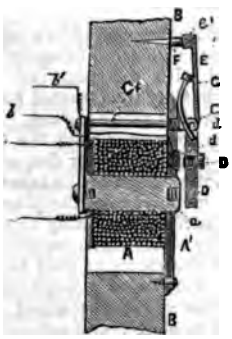
AN improved form of standard resistance coil has been devised by Professor Fleming, of the Cavendish Laboratory, Cambridge. The wire forming the resistance, instead of being bedded in paraffin wax as in the old forms of coils, is surrounded by an air space. This arrangement has the great advantage of enabling the wire to take the temperature of the medium in which the whole arrangement is immersed, in a few minutes.

SWAN ELECTRIC LAMP AT PLEASLEY COLLIERY.—The Royal Commissioners upon Accidents in Mines, including Professor Abel, Mr. Warington Smyth, Professor Tyndall, and others, made an examination last week of the experiments on the application of electric lighting to coal mines which are being carried out at the Pleasley Colliery, near Mansfield. The pits are about 1,600 ft. deep, and the workings are very extensive, but in the present instance the light was applied to three workings only, situated at a distance of about one-third of a mile from the bottom of the pits. The Swan system was adopted, and the arrangements were carried out by Messrs. R. E. Crompton and Co. The lamps themselves were inclosed in lanterns of a very ingenious construction, designed and made by Messrs. Crompton, which enabled the very fragile glass bulbs to be carried about without fear of accident, and at the same time rendered it impossible that the fracture of the lamp within could cause an explosion, inasmuch as the air inside the lantern would suffice for the instantaneous combustion of the carbon filaments before the flame could be communicated to the external air. In working the coal, the men undercut the face to the depth of some five or six feet, and the superincum-

bent mass is then brought down by wedges or blasting. It is said that the new lamp was found to be admirably suited for the requirements of the workers, since it not only gave a light many times as intense as the lights it replaced, but it was equally brilliant in whatever position it was placed, and it required absolutely no attention. In addition to the lamps which were used in the actual workings of the pit, the pit bottom was lighted up with similar lamps. The number of lights employed was 94 in all, which were worked by the current of an ordinary Gramme machine driven by a portable engine placed near the top of the upcast shaft.—*Journal of the Society of Arts.*

MR. EDISON has asked for 120 horse-power at the forthcoming electrical exhibition at Paris, to work his large generator.

MR. W. H. SAWYER has patented in the United States (Patent No. 242,055, filed Jan. 17th, 1881) the form of electric communicator, which is shown by the figure. In this invention the indicating-drop is held



in its upright position by a permanent magnet, whereby is obviated the throwing down of the drop by jarring, currents of air, rebounding, or other unintentional agencies. There is a pendant armature, D, provided with pin, G, a pivoted drop, E, and a magnetic pin, F. The pendant armature, D, is provided with a removable screw, D', a screw or contact-piece, *d'*, having a wire, *b*, connected to it, and a wire, *b'*, electrically connected with the armature.

DUBLIN ELECTRIC LIGHT COMPANY, LIMITED.—This undertaking has been formed with a capital of £150,000 in £10 shares, of which the first issue is 7,500 shares, for the purpose of introducing the electric light in Dublin for public and domestic use. The prospectus states that the company have entered into an agreement with the Anglo-American Brush Electric Light Corporation of London—the owners of the "Brush" Patents—to sell their patent machines, lamps, &c., and all future improvements thereon, exclusively to the company, for the county and city of Dublin. The price to be paid to the Anglo-American Corporation is £1,000 in cash and £9,000 in shares. The company are in negotiation for the lighting of several railway stations, factories, &c.

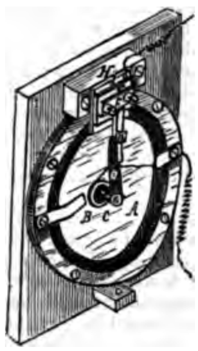
M. EMILE BERLINER, who claims to have been the original inventor of the contact telephone, has patented in America (Patent No. 241,912, filed Dec. 2nd, 1879) the form of the instrument, shown by the figure. His claims in his patent are as follows:—

1. In a contact-telephone or microphone, the combination, with the diaphragm and electrode vibrated by it, and a spring and electrode carried thereby, of a second spring projecting over and parallel with the first-named spring, and means, as indicated, for adjusting its pressure against the latter, and consequently of the two electrodes against each other, substantially as described.

2. In a contact-telephone or microphone, an elastic electrode, which is pressed against the opposite electrode by a spring, which can be shortened or lengthened as and for the purpose described.

3. In a contact-telephone or microphone, the combination of a vibrating surface forming one electrode, and being carried by a diaphragm in contact with a curvilinear convex surface forming the opposite electrode, the latter being attached to a flat spring, the elasticity of which is adjustable, substantially as and for the purpose set forth.

4. In a contact-telephone or microphone, the combination of a vibrating surface forming one electrode, in contact with the elastic opposition electrode, the latter being pressed against the former by a movable



piece, G, attached to a stationary spring, substantially as and for the purpose set forth.

5. The combination, with a spring and electrode carried thereby, of a second spring held stationary at one end, and arranged to bear against the spring carrying the electrode, and means, as indicated, for adjusting its pressure, substantially as described.

TELEGRAPHIC COMMUNICATION WITH SHETLAND.—The Shetland Islanders have a grievance in the very frequent interruptions in the telegraphic communication between Shetland and the South. There was not a single week all last winter that one or two annoying stoppages did not occur. The line passes over the Orkney Islands and through its impetuous tideways. There are no fewer than twelve land connections, and it lies on a rocky bottom. Early in the spring this matter was brought under the notice of the Postmaster-General; but Mr. Fawcett stated that a new line would cost £10,000, and that the present cable did not pay. On March 6th the cable broke altogether, and since then Shetland has been entirely without communication with the South by wire. A memorial was then forwarded to the Postmaster-General, in which it was argued that the sole possible trade of Shetland—its fishing—depended upon telegraphic communication with the markets for its development. Mr. Fawcett promised that no time would be lost in sending a telegraph ship to repair the existing line. The Shetlanders argue that it is not fair to hold them responsible for the sum of £4,000, which is annually expended upon repairs, almost the whole of which are rendered

necessary by the breakages in Orkney; and that for a sum not exceeding the amount expended every two years on such repairs they could have a direct cable, lying on a sandy bottom all the way, and steering clear of all tideways and land connections, which would last without repair for twenty years to come. They appeal to the members of the British House of Commons to help those who are trying all they can to help themselves.

Telephone School.—A telephone training school has been established at Upper Norwood, with the object of giving its pupils thorough practical instruction as electricians and experts, with a view to meet the demand for such persons which is constantly increasing. Mr. C. E. Winter, late of the Postal Telegraph Department, is the principal of the school.

The Electric Light in the Commons.—The second experiment of lighting the House of Commons by electricity during a debate was recently made, and the results were much more satisfactory than those on the previous trial a fortnight ago. Mr. S. Lefevre in the House, however, on Tuesday last, in reply to Mr. O'Shea, stated that he gathered from the general opinion of members that they were not satisfied with the result of the experiments; but they were made under considerable disadvantages. He would postpone further experiments until the recess. Twelve Brush arc-lights replaced the seventy-two gas ring-burners in the body of the House, and thirty-two small Swan lights took the place of the gas jets under the galleries.

The Electric Light in Edinburgh.—It is, we understand, proposed to select the Brush system for experimentally lighting Prince's Street, the North Bridge, and the Waverley Bridge. The cost of the three months' experiment will be about £390, but should the Town Council be satisfied with the results attained, the machines and other apparatus can be purchased for £2,400 less the above sum. It is also contemplated to establish a circuit to Holyrood, so that the Palace square may be well lighted during Her Majesty's stay in the city. The directors of the North British Railway Company have arranged with the Town Council for the lighting of the Waverley Station by electricity.

The Telephone in Hamburg.—The establishment of a telephonic network in Hamburg (says a German contemporary) is progressing most rapidly. Two hundred and thirty-one offices are already open, and almost every office and place of business in the town will ultimately be telephonically connected.

At a meeting of the Edinburgh Plans and Works Committee, held on the 16th ult., leave was asked to erect poles for telephone wires in various parts of the city on property belonging to the Corporation. Permission was given, and an annual rental of 2s. 6d. per pole imposed. A conversation took place on the dangers of overhead wires, but no recommendation made.

The inhabitants of Burray, one of the largest and most important of the Orkney Isles, are about to present a petition for telegraphic communication with the mainland.

A telegraph office is to be opened at Finstown, Orkney, under a guarantee of £22.

The Select Committee appointed by the House of Commons to inquire into the Herring Branding in Scotland, have reported in favour of a portion of the surplus branding fee being expended in aiding the Post-Office to extend telegraphic communication to some of the remote fishery districts.

By the erection of two new lines, and the substitution of telephones for Wheatstone's A.B.C. on the previously existing lines, the Post-Office has put the Dundee central police-station in telephonic communication with the various district stations, including Lochee.

Correspondence.

STORAGE OF ELECTRICITY.

To the Editor of The Telegraphic Journal.

Sir,—Since many are now interested in the so-called storage of electricity, I venture to describe a battery which I have recently devised, which gives very positive results.

Two carbon plates are placed in a solution of sulphate of zinc; the zinc in solution is easily deposited on the plate connected with the negative pole of a small Gramme. The battery thus treated has then a zinc and a carbon plate, and is ready for use. When it has run down it is again connected with the Gramme and re-charged, and is again ready for use, no zinc being lost. I have made another form of the same battery in which two surfaces of mercury take the place of the two carbon plates, one surface becoming an amalgam of zinc. I am now making exact measurements of all that takes place, and hope shortly to be able to make the results known. It is obvious that a large amount of waste in telegraph batteries might be reduced by subjecting the sulphate of zinc to electrolytic action.

Faithfully yours,
FREDERICK JOHN SMITH.

Taunton, *June 17th*, 1881.

ELECTRIC LIGHTING IN THE CITY.

To the Editor of The Telegraphic Journal.

Sir,—Referring to the letter of your correspondent, "Electrician," in your last number, I will take as correct his statements. These, however, do not in any way alter my views regarding the simplicity which is in "Jablochkoff," even in its working details. I may here remark that when the Embankment lights were first started the commutation or change of candle took place every hour and a half, and from each individual lamp-post. On a renewal of contract and increase on the number of lights used, an improvement took place, and one or two circuits were switched from the same spot. Progress has steadily gone on since, and now by the plan adopted, there is nothing to prevent any number of lamps being at once lit, and all commutation going on from the engine house itself. The "life" of the candle is now three hours, and I have no doubt before long *that* will be much increased. It matters little, as before said, what the *modus operandi* is, as long as a light, good and pleasant to the eye as to colour, is given, and at a price below gas. Now, whether two or twenty wires are required, I maintain that a system which enables three or four men to work and control from one spot, in some cases far distant from where the light is to be used, any number of electric lamps, is itself simplicity. The wires connected with its working, whether few or many, are merely a

matter of capital sunk, and if I judge by the quantity used in telegraphy and the results obtained, I have no fear of the operation of the "Jablochkoff" system of electric light being prejudiced or impaired by the question of number or length of wire. That the Metropolitan Board of Works have now got a contract for the Embankment on this system, costing them less than gas, and giving them a light transcendently greater, is, I believe, a fact, and speaks volumes. Comparisons are, doubtless, odious; but you will allow me to call your correspondent's attention to the three systems now before the public. The Metropolitan Board or Works have been lighting their great thoroughfare for nearly three years "without a failure for a single hour," without a change of a single screw to plant or lamp, save such as was necessary upon the extension or renewal from time to time during the above-named period. *Another* system within three months of its appearance had to suspend altogether for a fortnight, re-laying wires and taking down the whole of their lamps; while a *third*, after advocating lights of immense intensity, placed at a great altitude, have already lowered them 50 per cent. I say nothing in the last two cases of the occasional disablement and want of action—this all regulators are heir to. *The economy* of continuous currents is not disputed; but since it is attended by drawbacks which have puzzled electricians of all nations for nearly 50 years, I mean the unequal combustion of the electrodes, the cause being "regulators," more or less regular, from the earliest lamp to the multitude we have lately seen patented, I think that the claim for M. Jablochkoff's invention (the merit of simplicity) is but scant justice. It is indeed a wonderful invention, and the French nation took that view of it when bestowing on its author the Legion of Honour and the Gold Medal at the Exhibition of 1878. I must say I have looked in vain for anything that can approach it in scientific as well as practical value.

Your obediently,
Junior Carlton Club. ELECTRON.

TELEPHONIC PERTURBATIONS.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—I read with interest the communication of your correspondent "Telephone," in the last issue of the Journal, on the subject of telephonic perturbations, in which several experiments which had been made were carefully described. Several deductions from the experiments were also given, upon which, with your permission, I will venture a few remarks.

In the first place, it will generally be admitted by those who have had any experience of telephones that M. Gaiffe is perfectly right in concluding that part of the disturbance heard in the telephone is due to causes other than induction. If the office "leads" of the telephone, especially those of the primary circuit, are allowed to rub against each other, or against another object, the sound is reproduced in a magnified form in the telephone; and it is quite possible that the friction at a loose "binder" may produce sound in the telephone in like manner, or, as your correspondent suggests, it may be partly due to the vibratory action of the wind. Is it correct, however, to say that the wind "sets up currents" in the wires? Are not these peculiar noises, if they are really caused by the wind, simply waves of sound?

Secondly, I cannot conceive why it is necessary to put *telephone* circuits to a different earth from *telegraph* circuits, and I have not experienced the difficulty referred to by "Telephone." If he found that by using the earth of a *telegraph* circuit the movements of the telegraph apparatus were reproduced in the telephone, his earth must have been very imperfect, offering, as it must have done, a resistance equal to that of the telephone, or, what is more likely, the earth wire must have run for some distance alongside other wires in actual use, and thus caught up the induction. At the same time, if the water pipes of a town are used at one end of the line, and a copper plate at the other, a sufficient difference of potential may thus be obtained to excite the telephone.

Thirdly, galvanometers *might* be used on telephone circuits, but there are many decided objections to them. In the meantime, when an interruption occurs, renters presumably examine their connections, and, although galvanometers were supplied, they could do no more. It is useless to argue that renters would be enabled to indicate where the lineman should be sent. They could not do so without short-circuiting their apparatus, a proceeding which would be more likely to create than diminish faults. Any testing that is required can best be done by the lineman when he arrives with his detector, and, although he has to walk the entire length of the average telephone circuit, the "travelling and other expenses" will not be very serious. The cost of the galvanometers, and the resistance they would add to the circuit, are also important considerations—so important, indeed, that even in short telegraph circuits their use has been abandoned.

Yours obediently,
Edinburgh, *June 23rd*, 1881. INDUCTION.

IMPROVED ELECTRO-MOTIVE ENGINE.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—Referring to the article on an electro-motive engine on page 229, I should be very glad to receive the following information, either from the writer of the article, or some of your valuable correspondents.

(1.) Would the electro-motive engine driven by three of the bichromate cells give one man-power? if not, what power might be expected, also how many cells and what size would be required to give one man-power?

(2.) What quantity of solution should flow through each cell per hour?

(3.) Would it do to let the solution flow out of the first cell into the second, and then into the third one? if not, why?

(4.) What would be the weight of the electro-motive engine giving one man-power, also the probable cost?

VOLT.

New Patents—1881.

2484. "Improvements in and relating to the neutralisation of induced currents caused in telegraph and telephone lines by currents in other lines attached to the same posts or supports." W. P. THOMPSON. (Communicated by F. Van Rysselberghe.) Dated June 8.

2492. "Improvements in electric lamps and the manufacture thereof and in systems thereof." P. JENSEN. (Communicated by T. A. Edison.) Dated June 8.

2495. "Electric arc lights." E. G. BREWER. (Communicated by T. A. Edison.) Dated June 8.

2532. "Electric cables." G. E. GOURAND. (Communicated by P. B. Delany and E. H. Johnson.) Dated June 10.

2538. "Electric and magnetic breaks, method of utilising the energy required to stop a railway train or other vehicles suddenly, and in the utilisation of such brakes and connections for various purposes on trains and vehicles." M. R. WARD. Dated June 10.

2542. "Improvements in electrical insulated wires and conductors and in the means of insulation of the same." S. J. MACKIE. Dated June 14.

2554. "Apparatus for receiving and transmitting signals by electricity." A. F. ST. GEORGE. Dated June 13.

2563. "Electric lamps." G. G. ANDRÉ. Dated June 13.

2572. "Improvements in electric lamps and in means for bringing a number of carbons successively into circuit and for varying or extinguishing the light. H. E. NEWTON. (Communicated by C. A. Hussey and A. S. Dodd.) Dated June 14.

2573. "Improvements in means for supporting and protecting wires and other conductors used for electrical purposes." H. E. NEWTON. (Communicated by C. A. Hussey and A. S. Dodd.) Dated June 14.

2592. "Improvements in the manufacture of telegraphic or telephonic conductors or cables, and in machinery therefor." W. R. LAKE. (Communicated by H. A. Clark.) Dated June 14.

2593. "Electric clocks." A. M. CLARKE. (Communicated by J. Schweizer.) Complete. Dated June 14.

2606. "Electric accumulators or secondary batteries." A. MUIRHEAD. Dated June 15.

2607. "Improvements in electric bells; applicable also to relays and other electrical mechanism." W. P. GRANVILLE. Dated June 15.

2612. "Construction of electric lamps and apparatus for electric lighting." W. CROOKES. Dated June 15.

2618. "Governing dynamo-electric machines and electro-dynamic machines." J. JAMESON. Dated June 16.

2635. "An improved floating apparatus for generating and conveying electricity for the production of the electric light and the transmission of power." W. C. JOHNSON and S. E. PHILLIPS. Dated June 16.

2703. "Electric appliances for moving and otherwise operating upon train and like carriages." J. RICHARDSON. Dated June 20.

2711. "Electric danger alarms or signals, and other safety appliances for railways." S. A. B. PUTNAM. Dated June 21.

2712. "Improvements in the method of transmitting secret correspondence by telegraph or other public mediums, also in the apparatus to be employed therein." D. NICOLL. Dated June 21.

2739. "Improvements in the mode of, and apparatus for, distributing electricity, applicable to the production of the electric light, and for other purposes." H. E. NEWTON. (Communicated by A. Gravier.) Dated June 22.

2761. "A new or improved electro-magnetic induction machine for dividing a direct current into alternate currents." L. A. GROTH. (Communicated by D. Lachaussée.) Dated June 24.

2770. "Electrical resisting mediums more particularly adapted for use in vacuum and other electric lamps and tubes." R. H. COURTENAY. Dated June 24.

2782. "Secondary batteries." H. E. NEWTON. (Communicated by Société Universelle d'Electricité Tommasi.) Dated June 25.

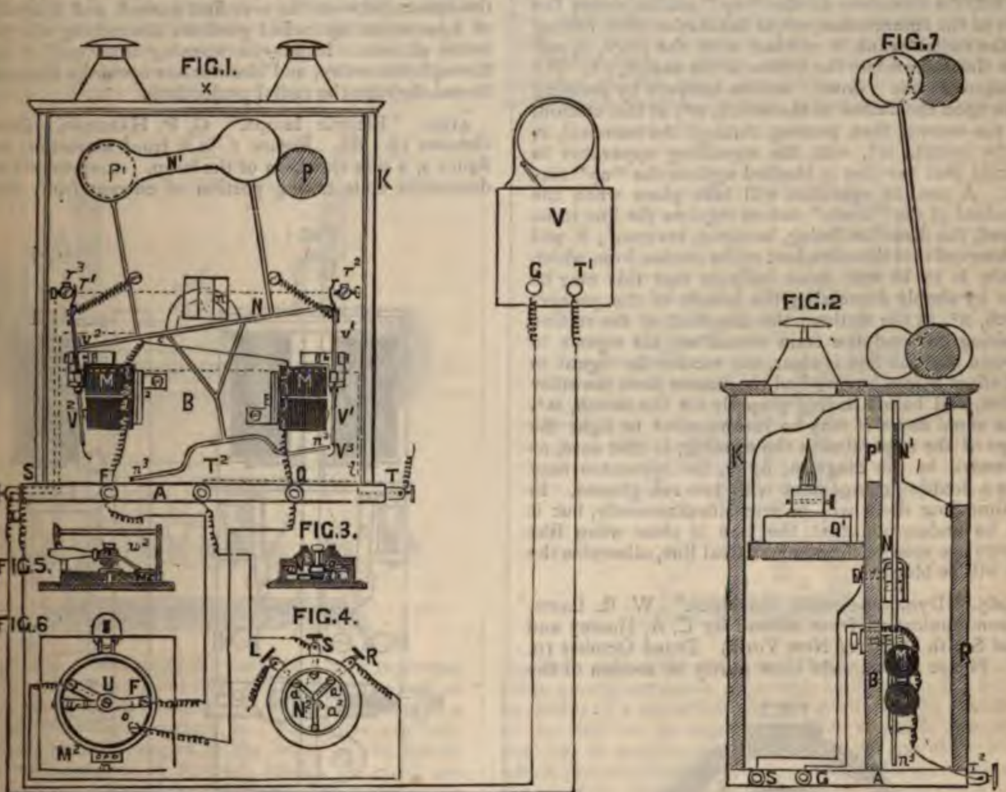
2788. "Means or apparatus employed in obtaining light by electricity." B. J. B. MILLS. (Communicated by F. Million.) Dated June 25.

2807. "Telegraph cables and other conductors of electricity." A. C. RANYNARD and J. A. FLEMING. Dated June 27.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1880.

4081. "Electrical signal apparatus for railways." W. R. LAKE. (A communication from abroad by Alfred Lemaire and Edmond Lebrun, both of Paris.) Dated October 7. 6d. Relates to apparatus for signalling on railways, which apparatus is particularly adapted for use in connection with single lines. Fig. 1 is an elevation of the apparatus with the outer casing removed. Fig. 2 is a sectional side elevation of the same in front of the swinging frame. Figs. 3 and 4 show the pusher-switch in section and in plan with the cover and pusher removed. Figs. 5 and 6 show in section and in plan the two-way switch or commutator. Fig. 7 is a diagram illustrating a modification of the invention. At each of the two stations to be placed in communication there is an electric signalling apparatus, X, a pusher-switch, N^2, a two-way switch, M^2, and an electric bell, V. The signalling apparatus (figs. 1 and 2) consists of a board or plate, A, carrying terminals, F, T^2, O, T, S, C, and supporting a vertical board or plate, B, upon which are mounted two electro-magnets, M, and M^1, for operating the swinging frame, N; this frame is suspended at n, and carries the double screen, N^1, which allows the alternate closing of the red light shown by the disc, P, and the white light shown by the disc, P^1. These lights are produced by lamps such as that shown at Q^1, placed before reflectors, q^1, by which such lights are reflected. The whole of this signalling apparatus is inclosed in a box, R, provided in front with sight-holes for the disc, P and P^1, and also with chimneys for the lamps, Q^1. The impulse to the swinging frame for causing the same by changing its position to uncover the red or white light is imparted by the impact of the pallet or armature, V^1 or V^2, of the electro-magnet upon the end, n^2 or n^3, of the arm of the swinging frame when either of the pallets is under the influence of a current, the pallet then being suddenly attracted towards the magnet. Thus when the parts are in the position shown in the figure, and a current passes through the electro-magnet, M, the pallet, V^1, being suddenly attracted, will, by its end, V^3, strike the end, n^2, of the swinging frame, which will be brought into such a position as to cover the red light and uncover the white light—that is to say, the apparatus will be set to indicate "line clear." In this position the swinging frame will be engaged by the upper arm, v^2, of the pallet, V^2, of the electro-magnet, M^1, in the same manner as it was engaged by the upper end, v^1, of the pallet, V^1, of the electro-magnet, M, by which end the frame was released before the impulse causing it to change its position was imparted to the lower end thereof. When a current is passing through the electro-magnet, M, and the swinging frame is in the position shown in the drawing, the pallet has no effect upon the swinging frame; but the current at the moment the pallet comes in contact with the soft iron core of the electro-magnet passes through the said pallet, the upper part of which by means of the small springs, r, is brought in electrical contact with the terminal, r^2, which communicates with the earth-wire. This current in passing actuates the bell, which ceases

o operate at the moment of contact of the springs, r ɪr r^1, with terminal, r^2 or r^3, and the pallet is returned o its vertical position by the action of a small spiral pring. The operation of this apparatus is as follows:— \ current arriving through the terminal, F, passes hrough the electro-magnet, M^1, to the terminals, C and :^{1}, and to the bell at V. A current arriving by the erminal, O, passes through the electro-magnet, M, hence to the terminal, C (through the branch at c), and hence to the terminal, C^1, of the bell, V. Finally, a urrent passing through the terminal, T, connected with he earth passes through the branch, t, and the terminal, T^2, or through the terminals, r^2 and r^3, thence to the terminal, S, and subsequently to the terminal, T^1, of the bell, V. Thus a current arriving at F in the switch, M^2, serves to set the signals to indicate "train on line," at



the same time ringing the bell, or the current serves only to ring the bell when the signals are already set to this position. A current arriving at O, in the switch, M^2, causes the apparatus to indicate "line clear," and actuates the bell at V; the earth wire of the line serves to establish communication with the springs which form the end or upper extremity of the pallets and causes the bell to operate. The pusher-switch, N^2 (figs. 3 and 4), consists of a wooden socket furnished with a cover carrying a pushing-stud or button provided with a spring, and when pressure is exerted upon the said button the extremity of a contact piece, a (which in its normal position is always in contact with the contact piece, a^1), is put in contact with the end of another contact piece, a^2, which is connected with the terminal, S; the latter is connected with the terminal, T^2, and the signalling apparatus. The contact piece, a, is connected with the line-wire by the terminal, L, and the contact piece, a^1, is connected with the terminal, R, in such manner that ordinarily the terminals, L and R, are connected, and the terminal, S, is ordinarily insulated. When contact of the two contact pieces, a and a^2, is caused by depressing the stud of the pusher-switch at one station, the "up" station for instance, and the terminals, S and L, are thereby connected, the current passing from the terminal, T^2, through the terminal, S, will actuate the bell at the other station (in this case the "down" station), and the line will be made clear for or blocked against the same as may be required. The two-way switch, M^2 (figs. 5 and 6), consists of a wooden socket having two terminals, F, O, and a central terminal, U, in connection with the terminal, R, upon the pusher switch, N^2. Upon the central terminal is mounted a switch crank or manipulator, u^1, which serves to direct the current, arriving from the line through the terminal, R, to the terminals, F or O, connected with corresponding terminals upon the signalling apparatus, X. Ordinarily the switch-crank, u^1, connects the central terminal, U, with the terminal, F, and the handle of the switch is held in the side of a cover hinged at m to the said socket, and secured by a padlock or other device on the opposite side, so that this switch cannot be directed to the terminal, O, unless the cover be unlocked, in which case the said cover can be opened and the switch-crank may be turned around the axis of the central terminal. When, therefore, the attendant at one of the stations, say, the "up" station, requires to have the line clear, he depresses the button of the pusher-switch, N^2, so as to operate the bell at the other station, as above stated. The attendant at the latter answers by depressing the

button of the switch, N², at the "down" station. The current coming from the line passes through the terminals, L and R (the terminal, S, being disconnected), goes from there to the central terminal, U, of the switch, M², passes through the terminal, F, thereof to a terminal of the signalling apparatus, X, and actuates the bell of the "up" station, as hereinbefore explained, then the attendant at this station opens the cover of his switch, M², places the switch-crank upon the contact piece, O, and presses twice upon the button of the switch, N², to inform the "down" station by two rings of the bell that the "up" station is in readiness to have its signal opened. The attendant at the "down" station by pressing upon the switch stud sends the current, which passing through the contact piece, O, of the "up" station actuates the signalling apparatus. When the train is sent off, the attendant at the "up" station closes the cover of the commutator, M², at the station after having put the switch crank in contact with the piece, F, and three times depresses the button of the switch, N². The attendant at the "down" station answers by pressing again upon the button of the switch, N², at this station, and the current then passing through the terminal, F, of the switch, M², sets the signalling apparatus to indicate that the line is blocked against the "up" station. A similar operation will take place when the attendant at the "down" station requires the line to be cleared, the direction being, however, reversed; it will be observed that the attendant at the station from which a train is to be sent must indicate that this may be done by simply depressing the button of the pusher-switch, N², at the station; the attendant at the station requiring to send the train cannot set his signals to indicate that the line is clear, nor receive the signal to that effect before having had the answer from the other station, and before having properly set the switch, M². As in some cases it may be inconvenient to light the lamps of the apparatus in the evening, in that case, as illustrated in the diagram, fig. 7, the apparatus may have a double arrangement with two red glasses. In daytime four discs will be seen simultaneously, but it will be understood that the line is clear when like colours are seen in the same vertical line, otherwise the line will be blocked.

4265. "Dynamo-electric machines." W. R. LAKE. (A communication from abroad by C. A. Hussey and Amzi Smith Dodd, of New York.) Dated October 19. 6d. Figure 1 is a side view partly in section of the

FIG.I.

new machine. A represents the magnet, which consists of a circular bar of cast iron, round in transverse section; B, B represent transverse projections from the magnet, A, which projections project inwardly and *radially* therefrom; C, C, designate arc-shaped extensions from the inner ends of the said projections, which extensions are concentric with the magnet, A. The wire is wound on the magnet, A, to an extent sufficient to make it on the inner side of the magnet form a continuation of the circle of which the extensions, C, are arcs, so that the armature before the poles or consequent points will rotate before the whole length of the magnet and wire wound thereon, and hence through the whole field of force all at the same time, whereby the effectiveness of the machine is greatly increased. F represents an armature comprising radial projections, *b*, and intervening spaces, *c*, in which the wire wound between the said projections is contained. The said armature is of a skeleton-like construction, consisting of a series of arcs of a circle, another series of arcs of a larger but concentric circle arranged opposite the spaces between the arcs first named, and a number of approximately radial portions connecting the two series of arcs. It has an opening from end to end through the centre, and likewise has openings from end to end through the radial projections.

4191. "Electric lamps." G. P. HARDING. Dated October 15. 6d. Figure 1 is a front elevation, and figure 2, a side elevation of the lamp. *a* represents the derivation coils taking portion of current from main

FIG I

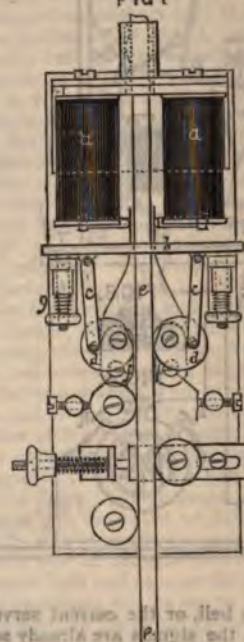
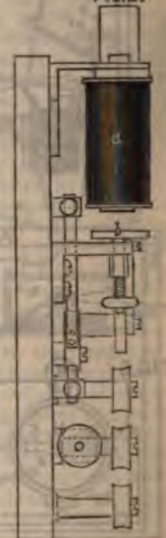


FIG.2.



circuit. *b* the armature acting on the levers, *c*, *c*, and through them on the cams, *d*, *d*, which grip the carbon, *e*; *f* the cock on which the cams, *d*, swing. Assuming the lamp to be at rest, and the carbon, *e*, not resting on the lower carbon (not shown), directly connection is made from the machine to the lamp a portion of the current goes through the magnets, *a*, *a*, being the route of least resistance, the armature, *b*, is attracted, and actuates the cams, *d*, which open and release the pressure on the carbon; the current now

passing between the two carbons the magnets become inactive, and the springs, g, g, pull back the armature and actuate the cams in the contrary direction, causing them to close and lift the carbon a short distance and establish the arc.

4310. "Apparatus for separating particles of iron from grain." W. R. LAKE, of the firm of Haseltine, Lake & Co., Patent Agents, Southampton Buildings, London. (A communication from abroad by S. Howes, N. Babcock, and C. Ewell, of New York.) Dated October 22. 6d. Relates to that class of magnetic separators which are employed for separating from grain, previous to grinding the same, any fragments of wire or other pieces of iron which may be mixed with it. The objects of the said invention are to so construct the separator that the particles of iron which are arrested by the operation of the magnets will be automatically removed from the surface on which they lodge, and that the magnets can be readily inserted within or removed from the compartment in which they are arranged. Figure 1 is a front elevation and figure 2 a longitudinal section of the machine. A, A represent the side walls, B the front wall, and C the rear wall of the compartment or chamber in which are arranged a series of horse-shoe magnets, D. The latter are bent in a plane at right angles to the width of the bar of which each magnet is formed; blocks of wood are arranged between the magnets, secured by a tie-rod, e. The blocks are shaped to fit snugly in the compartment formed by the walls, A, B, C, so that when they are placed in the same the magnets will be held in place without requiring any other fastening; F represents the top plate of the compartment in which the magnets are arranged. This plate is arranged in an inclined position at an angle at which the grain intended to be freed from the accompanying iron will run. The said plate, F, is provided with an opening, f, through which the ends of the magnets, D, project, and which is made of the same size as the compartment in which the magnets are arranged; G, G represent the side walls of the upper part of the frame of the machine; H is the rear cross plate, and I the bottom plate of this part of the frame. The upper part of the frame is connected with the lower part of the frame by a hinge, i, which permits the upper part to be swung back, whereby the opening, f, is exposed, so that access may be had through the said opening to the compartment in which the magnets are arranged for the insertion or removal of the same; K represents the feed-hopper arranged between the side walls, G, over the upper part of the plate, I, and provided with a plate, L, whereby the flow of grain from the hopper is regulated. An overflow aperture, l, is made in this plate, L, for the purpose of always maintaining a supply of material in the hopper. The bottom plate, I, of the upper part of the machine rests upon the top plate, F, of the lower part of the machine, and is inclined at the same angle as that of the top plate, F, of the lower part. The said plate, I, is provided with an opening, m, into which the poles of the magnets project; N is a plate of zinc secured to the upper side of the plate, I, and extending from the rear plate, H, downward to the edge of the plate, I; O is a wiper or scraper whereby the particles of iron which adhere to the plate, N, are removed from the latter. This wiper, O, traverses the said plate, N, in one direction only, and is attached to an endless belt, P, which passes over two pulleys, p, arranged on the outer side of the side walls, G, and supported in suitable bearings, p^1, which are secured to the outer side of the walls, G. The bearings of one of these pulleys are made adjustable in line with the belt by means of a screw bolt and nut, q, whereby the tension of the belt can be regulated. This wiper, O, is composed of an angular piece having a tight top plate, O^1, which prevents the grain from entering the space below the plate, O^1, when the wiper traverses the zinc plate, N. The upper part of the belt, P, passes over the plates, G, and the lower part of the belt passes through openings, r, which are formed in the side plates, G, and which are made large enough to permit the wiper to pass through the same. Motion is imparted to the belt by means of gear-wheels, S, and a pulley, S^1. The grain to be treated is conveyed into the hopper, K, from which it flows upon and over the zinc plate, N, and is discharged over the lower edge of the latter. The particles of iron which are mixed with the grain are subjected to the attraction of the magnets exerted through the zinc plate, N, and are thereby arrested and held on this plate while the grain passes on. At certain intervals according to the speed of the belt, the wiper, O, traverses the plate, N, and gathers the particles of iron which have lodged on the same, and moves them to one side of the plate, where they are discharged through the opening, r, into any suitable receptacle. The plate, O^1, at the head of the wiper, O, prevents the

FIG. 1.

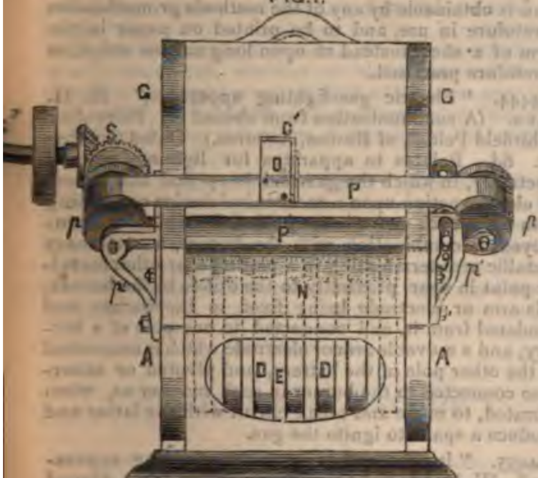


FIG. 2.

grain from coming in contact with that side of the wiper against which the particles of iron accumulate as they are moved over the plate, N, and it thereby prevents any grain from becoming mingled with the iron. The frame of this wiper is made entirely or partially of magnetic material, so that in passing over the conveying surface, it will be drawn down thereon by magnetic attraction, and its edges are faced with strips of india-rubber or similar material.

4391. "Measuring the amount of electrical current flowing through a circuit." P. JENSEN. (A communication from abroad by Thomas Alva Edison, of America.) Dated October 27. 6d. A depositing cell is used in which plates are suspended but insulated from a balanced arm, to which is attached a lever arm, on which is a weight adjustable on a lever arm, so that the amount of excess of weight upon one plate over the other required to cause a tilting of the balanced arm may be determined and regulated. The cell so arranged is placed in a branch circuit, so that a definite fraction of the current used shall traverse the branch circuit and depositing cell. As the weight of one plate is increased by the deposition of, say, copper from the solution, it will tip the balanced arm whenever the weight of the increase becomes sufficient to overbalance the weight alluded to as on the lever arm. The lever arm moving causes a movement of a registering apparatus registering each tip, and at the same time causes a reversal of the current through the cell, the effect of which is that the copper is absorbed or removed from the now heavier plate and deposited upon the lighter, until it in turn becomes the heavier, causing another tipping, another registration, and another reversal. As the amount of current needed to cause the deposition of metal enough to cause the tipping is known, and as it is a definite percentage of the entire current, the registration may indicate the total amount of current; or as the ratio existing between current and feet of gas for illuminating effect has been determined, the registration may indicate the equivalency in light of feet of gas.

4393. "Electric lighting apparatus." W. R. LAKE. (A communication from abroad by Hiram Maxim, of

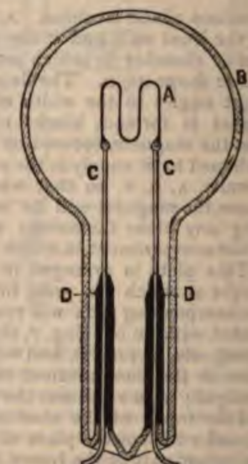
New York.) Dated October 27. 6d. Relates to incandescent lamps in which means are provided for the easy removal and replacement of the carbon slip when required. The lamp has a stopper with a rim or lip, *e*, *turned up* about the edge of the neck of the globe, and the neck is joined to this lip by means of a ground joint. The lip flares out slightly above the joint so as to form a trough for the reception of gum or other sealing material, and is recurved, as shown, so that the material used will not run out when the lamp is inverted.

4428. "Electric lamps." J. H. JOHNSON. (A communication from abroad by Albert Berjot, of Paris.) Dated October 29. 4d. Relates to electric lamps, and it consists chiefly in the employment of a regulating apparatus arranged in the form of a parallelogram with flexible spring joints in combination with a number of pairs of carbons which are consumed in succession, the current being automatically diverted into a fresh pair when the pair in use for the time being has been consumed. (*Provisional only.*)

4434. "Telegraphic recording apparatus." T. M. FOOTE, of New York. Dated October 30. Relates to improved mechanism for recording in a legible manner despatches, messages, or other communications transmitted by means of electricity, and consists in various improvements for causing the letters, figures, or other characters forming the message or communication to be printed upon a piece of paper in a better manner than is obtainable by any of the methods or mechanism heretofore in use, and to be printed on paper in the form of a sheet instead of upon long narrow strips, as heretofore practised.

4444. "Electric gas-lighting apparatus," H. H. LAKE. (A communication from abroad by Florentine Whitfield Pelton, of Boston, America.) Dated October 30. 6d. Relates to apparatus for lighting gas by electricity, in which the gas-cock is opened and closed by electric action upon a mechanical device connecting with such cock and a battery, and in which are employed, in combination with the burner, a stationary metallic arm terminating in a platinum or other metallic point in near proximity to the orifice in the burner, this arm or electrode being fixed to the burner and insulated from it, and connected to one pole of a battery, and a movable arm or electrode which is connected to the other pole of the battery, and pivoted or otherwise connected to the burner in such manner as, when vibrated, to make and break circuit with the latter and produce a spark to ignite the gas.

4495. "Improvements in electric-lighting apparatus." W. R. LAKE. (A communication from abroad



by Joseph V. Nichols, of New York.) Dated November 3. 6d. Relates to incandescent lamps. A is the

andescent conductor; B is the glass globe in-sing the conductor; C, C are conducting wires of pper; D, D are tubes made of cement (composed by roughly mixing and fusing together fifty-eight parts weight of oxide of lead, seventeen parts of silica, parts of oxide of iron, ten parts of oxide of copper, l five parts of potash or soda), fused and sealed to conducting wires at their upper ends and to the ss of the globe at their lower ends, so that the base the globe is hermetically sealed about the said con-ting wires. The tube of cement is joined to the e when both are at a white heat, so as to remove all de from the surface of the metal and insure perfect esion between the parts. By way of additional caution a second joint is made between the tube l the wire, a short distance below the upper end of tube. The air is exhausted from the globe in the al way, so as to leave as perfect a vacuum as prac-able.

4515. "Electrical mouthpieces." JAMES DUNBAR. ted November 4. 2d. Relates to improvements in nking vessels, for imparting electric currents to fluids ilst passing into the mouth. One or more opposite tals (or negative and positive metals) are used in njunction with any insulating medium, in connection th the rims of drinking vessels, tubes, or mouthpieces any description, whereby an electric current is ob-ined in the liquid or moist fluid as it passes over the id metals, or negative and positive poles, into the outh, and also sometimes a current in the mouth. *rovisional only.*)

4621. "Magneto-electric signal apparatus." E. G. REWER. (A communication from abroad by E. H. hnson and T. A. Edison, of America.) Dated Novem-r 10. 6d. Relates to an attachment to magneto-ectric machines by which the latter can be cut out of rcuit when not in use, being thrown into circuit only hen in use.

Proceedings of Societies.

PHYSICAL SOCIETY.—JUNE 11th.

Lord RAYLEIGH in the Chair.

New Members—Mr. J. E. H. Gordon and Mr. J. E. tead, E.I.C.

Professor FLEMING exhibited a new form of B.A. Unit esistance Coil, devised by him for experiments in the avendish laboratory, with a view to obviate the akage in the older form due to condensed moisture n the paraffin insulating the electrodes, and also to cilitate the equalisation of the temperature of the coil ith the medium it is placed in. For this purpose the ire is wound bare, each layer being insulated from the est by ebonite fenders niched to receive turns, and the oil is inclosed in a brass box, screwed together. This ox is watertight and may be soldered or provided with n india-rubber washer between the two flanged halves which screw together.

Dr. STONE said he usually insulated the B.A. coil when plunging it in water by putting it in a beaker of paraffin oil which was immersed in turn in the water.

Professor AYRTON pointed out the advisability of makers aiming rather at turning out exact resistances of any definite value than wasting time and increasing the cost of the coils by adjusting them to a given figure, such as one or ten ohms.

Professor W. CHANDLER ROBERTS read a paper on the hardening and tempering of steel. He pointed out that few questions connected with the metallurgy of iron or steel are attracting more attention now than the relation between a metal and the gases it comes into contact with during manufacture. The carbonisation of iron has long been of great interest, as shown by the work of Clouet at the end of last century, and that of Margueritte in 1865, who showed that though the conversion of iron into steel could be effected by contact with carbon, even in the diamond form, it is nevertheless true that in the ordinary process carbonic acid plays a considerable part, which had been overlooked. Graham's 1867 paper on the occlusion of gases by metals gave point to Margueritte's work by showing that carbonic oxide can penetrate to the centre of a mass of iron. It is introduced, in fact, at a comparatively low temperature, while a high temperature is necessary to enable the metal to appropriate the carbon and become steel. Metallurgists are now carefully investigating the effect of occluded gases in iron and steel.

Professor ROBERTS considered the point recently raised as to whether the hardening and tempering of steel might not be influenced by the occlusion or expulsion of gas. He described experiments by which he proves that as steel hardens when rapidly cooled in vacuo, gases could not play any part in the tempering. He also dwelt on the precautions necessary to keep the metal in the experiment free from occluded gas. He then showed that Bergman (to whom we owe our knowledge that the difference between wrought iron and steel depends on the carbon in the latter) showed, in 1781, that fixed air could give up its carbon to iron; and he concluded by showing that Reaumur, so long ago as 1722, actually employed the Toricellian vacuum in experiments on the tempering of metal, the metal being placed red-hot in a highly rarefied atmosphere. Reaumur also had a clear view of the effect a gas might have on the physical properties of a metal, a point of great interest to physicists in general.

Professor HUGHES expressed the opinion that temper was not due to absorption of hydrogen, but to the absorption of carbon in the iron.

Mr. STROH found that an electrically fused steel contact was glass-hard.

Professor GUTHRIE exhibited a steel chain which he had beautifully blackened by dipping in fused nitre. The skin might be useful in the arts, and was, perhaps, analogous to that produced by Barff's process.

Lord RAYLEIGH, Mr. WALENN, Mr. LECKY, Dr. COFFIN, Professor AYRTON, and others, continued the discussion.

Mr. GRANT then read a paper on curves of electro-magnetic induction, which he had traced out by means of primary and secondary coils sliding on frames, so as to take different positions with respect to one another. The paper was illustrated by experiments and diagrams.

Professor REINOLD then read portions of a paper by Professor S. P. Thomson, on the opacity of tourmaline crystals. The optical and electric properties of these crystals are related, and Professor Thomson propounds an explanation of this connection based on the late Clerk-Maxwell's electro-magnetic theory of light. The full paper will be published in the *Journal* of the Society.

JUNE 25TH.

Professor FULLER in the chair.

Sr. OLYMPIO DE BARCELOS elected a member.

Mr. GRANT exhibited an apparatus for showing the position and direction of the curve of zero electro-dynamic induction. It consisted of two coils of insu-

lated wire mounted on stands, one being fixed, while the other was free to revolve round it at a fixed distance.

Prof. W. E. Ayrton explained the determination of the refractive index of ebonite made by himself and Prof. Perry. The result for oxyhydrogen light was 1·7; but at the suggestion of Prof. Fitzgerald, of Dublin, this was checked by measuring the polarising angle of ebonite by reflected light. Sunlight was employed in these experiments, and different pieces of ebonite. The result was 1·611. Professors Ayrton and Perry had repeated their former experiments, using the electric light and a battery of 70 volts E. M. F. The result confirmed the one first obtained. They had also determined the index of refraction in the ordinary way from the red rays which they observed to pass through the prism of ebonite. Result for the least refrangible rays, 1·66.

Mr. Boys remarked that one could see better through thin ebonite if it was varnished or wetted than when untreated.

A letter was read by the Chairman from a sub-committee of the British Association, inviting the members of the Society to send exhibits to the jubilee meeting of the B. A. at York.

Dr. James Moser read a paper on the microphonic action of selenium cells, in which he argued that the action of the selenium cell in the photophone was that of a microphonic contact or bad joint between the metal electrodes or metal plates of the cell and the selenium. The heat rays of the photophonic beam caused the joint to expand and contract; hence the variation in the current passing through the receiving telephone. Dr. Moser also exhibited a piece of selenium which increased, not diminished, in electric resistance when light fell upon it. He further showed a standard Daniell cell of the gravity type, which consisted of a glass vessel containing the copper plate at the bottom, immersed in sulphate of copper solution, and the zinc plate at the top, immersed in sulphate of zinc solution; and a clear line of demarcation between these solutions was produced by suspending an independent piece of zinc midway between the plates, so as to decompose all the sulphate of copper which diffused upward to that point.

Prof. Macleod said that he had produced the same result by surrounding the zinc plate with a cage of copper wire connected to the copper plate. Copper deposited on the cage and the cell was in constant use. Dr. Lodge said that arrangement would not, however, serve as a standard of electromotive force, because all the copper-plate should be in the copper solution. In his cell the copper and solution are both in a test tube, immersed in the zinc solution, and diffusion has to take place up this test tube and down the cell, so as to enter a second tube open at the bottom in which the zinc is placed.

Dr. Guthrie showed a new experiment to the effect that where a magnet is suspended over a disc of copper and the disc is rotated, the magnet is repelled upwards. The experiment was shown by suspending a horse-shoe magnet from one end of a scale beam counter-weighted. As a possible explanation, he suggested that the vertically resolved force of the induction current before the magnet might be greater than than that behind the magnet.

The Secretary read a paper by Professor Balfour Stewart and Mr. W. Strode, on results obtained by a modification of Bunsen's calorimeter, described to the Society in January last year. With a new instrument made by Casella they have determined the mean specific heat of iron to be 0·1118, and that of sulphur 0·1756—the true values being given as 0·1138 and 0·1776. The advantage of the method is its simplicity and the fact that very small quanti
substance may be used.

Dr. Lodge then explained experiment
Sutherland, showing that a Daniell cell
E.M.F. very constant when heated, bec
thermo-electric effect at the junction of the
the solution is balanced by that at the juncti
copper with the solution.

After remarks by Dr. Moser and Profess
the Society separated until November next.

The announcement is made in New Yo
contract was signed on May 25th betwee
Grant, on behalf of the International Ocean
Company, and the Mexican Government, f
cable between the United States and the We
Mexico, and Central America, by way of
Yucatan, the work to begin immediately.

The telegraph steamer *Faraday* arrived
End on the morning of the 28th ult. and pick
buoyed end of the new American Cable, after
proceeded to pay out.

A New York telegram of the 27th ult.
The duplicate telegraphic cable from Key
Havana has now been completed.

The following are the final quotations of st
shares for the 29th ult.: — Anglo-American, Limi
Ditto, Preferred, 84-85; Ditto, Deferred, 24½-25
Sea, Limited, ——; Brazilian Submarine, Limited
Brush Light, ——; Electric Light, —— Co
Telephone Construction, ——; Cuba, Limited, 9½-
Limited, 10 per cent. Preference, 16¾-17¼; Direct
Limited, 4¾-5; Direct Spanish, 10 per cent. I
13½-14½; Direct United States Cable, Limit
10½-10¾; Debentures, 1884, 103-105; Eastern
10⅝-10⅞; Eastern 6 per cent. Preference, 12⅝-13⅛
6 per cent. Debentures, repayable October, 1883,
Eastern 5 per cent. Debentures, repayable Aug
103-106; Eastern, 5 per cent., repayable Au
106-109; Eastern Extension, Australasian an
Limited, 11⅛-11⅜; Eastern Extension, 6 per cent. D
repayable February, 1891, 109-112; 5 per cent. A
Gov. Subsidy Deb. Scrip, 1900, 106-109; Ditto,
repayable 1900, 106-109; Ditto, 5 per cent. De
1890, 103-105; Eastern and South African,
5 per cent. Mortgage Debentures, redeemab
106-109; Ditto, ditto, to bearer, 105-108;
Union Telegraph and Trust, 11¼-11¾; Globe Teleg
Trust, Limited, 6¼-6½; Globe, 6 per cent. Preference,
Great Northern, 13½-13¾; 5 per cent. Debentu
107; India Rubber Company, 20½-21½; Ditt
cent. Debenture, 107-110; Indo-European, Limited
London Platino-Brazilian, Limited, 5¾-6¼; Medit
Extension, Limited, 2½-3; Mediterranean Extensi
cent. Preference, 9¼-9¾; Oriental Telephone, ¼-½;
Limited, 11-12; Submarine, 280-290; Submari
2¾-3; Submarine Cables Trust, 103-106; Unit
phone, ——; West Coast of America, Limite
West India and Panama, Limited, 2-2¼; Ditto
cent. First Preference, 7½-8; Ditto, ditto, Second Pr
6¾-7¼; Western and Brazilian, Limited, 8¾-9; Dit
cent. Debentures "A," 108-110; Ditto, ditto, dit
98-102; Western Union of U. S. 7 per cent., 1 M
(Building) Bonds, 123-128; Ditto, 6 per cent.
Bonds, 106-110; Telegraph Construction and M
ance, Limited, 32-32½; Ditto, 6 per cent. Bonds, 1
Ditto, Second Bonus Trust Certificates, 3¾-4¼.

THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. IX.—No. 203.

THE FAURE SECONDARY BATTERY.

THE exhibition of a number of the Faure cells at the scientific *soirée*, given recently at King's College, London, attracted a good deal of attention, as it was the first practical exemplification in this country of the powers of this most recent electrical novelty. As regards the possibility of using the apparatus for lighting purposes, the exhibition was a success; 20 of Swan's incandescence lamps were kept lighted from 44 of the Faure cells.

In estimating the practical utility of the invention, a great number of points require to be considered, and care should be taken to avoid drawing an unfair conclusion from the results of experiments made under unsuitable conditions. We hear that 160 of the Faure cells, costing £800, and weighing a ton and a half, were recently tried for driving a tram-car in the streets of Paris; as a commercial question this result cannot be regarded otherwise than as unsatisfactory, but the only conclusion that should be drawn is, that for the particular purpose the apparatus is unsuitable. Stored energy, in the form of compressed air, which has again and again been proved to be successful for locomotive purposes, practically leaves stored electricity nowhere—that is, in the form in which it at present exists. It must be recollected, however, that stored energy in the form of compressed air cannot give out light directly, as stored electricity can, and that, therefore, the latter in this case has the advantage.

The great difficulties to be contended with before the storage of electricity can be pronounced to be a practical success are those of mass, time, and durability; the latter in the case of the Faure battery has yet to be proved to be sufficiently great to enable it to affect as little as possible the general working expenses. The element of time is a very important one, and unless it can be brought within reasonable bounds, it may prove a very serious obstacle to the success of the Faure system. It is the one element of which but little information has yet been received, and yet it is of the highest importance. If, as appears to be the case, as long a time is required to charge the cells as is required to discharge them, the electricity generated by the dynamo machine might almost just as well, in the majority of cases, be delivered direct from the machine as from the battery. In cases where the Faure battery would be really useful—that is, where it would be inconvenient to have machinery erected, or to have wires extended to convey the power—then the element of mass becomes a serious obstacle; great weight and large bulk compared with the amount of energy stored, the secondary cells certainly possess, and at present there does not seem much prospect of these being much reduced, and nothing less than a wholesale reduction in these respects can, we think, make the arrangement a success. One horse-power per hour contained in a weight of 75 kilogrammes is not a large amount, and yet this quantity, which is claimed for the Faure cells, is stated, and has been proved by experiment, to be very much in excess of the truth. No doubt the economical storage of electricity will be effected sooner or later, and when it is thus effected it will mark an era in mechanical science, but as yet it is very far from being successfully carried out.

RAILWAY SIGNAL REPEATERS AND LIGHT INDICATORS.

By E. T. ROLLS, A.S.T.E.,
Superintendent Western District, L. & S. W. Railway.

IT will be obvious to all acquainted with railway working that, no matter how perfect is the electric block apparatus for signalling trains, the safety of those trains must ultimately depend upon the electric signalling being accurately translated to the engine drivers by a correct signal out on the line. It being, therefore, of vital importance that the signalman should show a correct signal, it becomes a necessity that he should have means of assuring himself of the position of his signals, when from a multiplicity of causes they are out of sight from the cabin.

Mechanical methods of various kinds have been employed for this purpose, but they have, as a rule, proved cumbrous and made way for electrical apparatus.

The subject has had my attention for some years, and the means I have devised for meeting the requirement having stood the test of practice, a description of them may be interesting to some of the readers of this Journal.

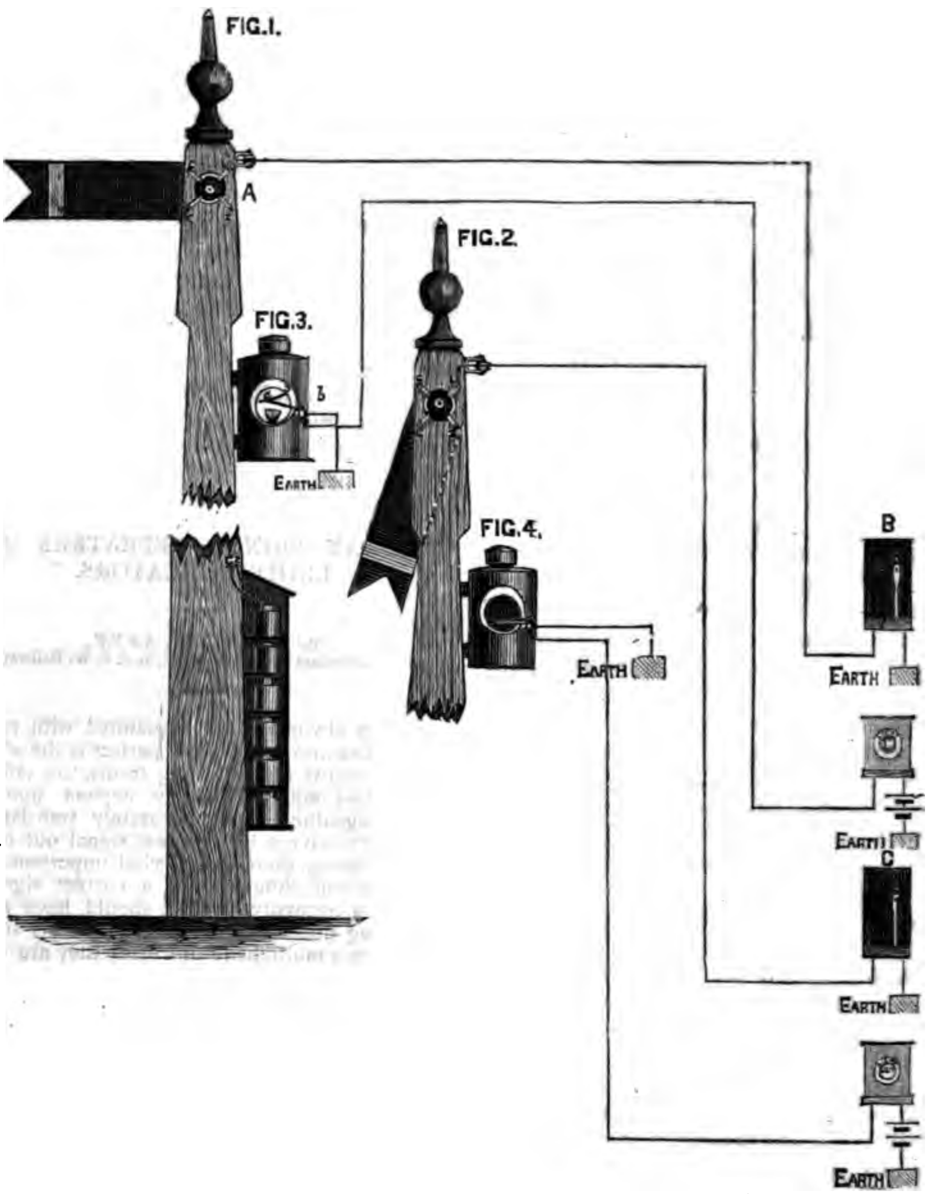
SIGNAL REPEATERS.

From the context it will be plain that these, to be efficient, must be free from liability to error by the effects of line faults—earth or disconnection, and a great number being required upon a railway, they must be cheap.

The first condition is obtained by arranging the

battery at the signal post. Earth or disconnection then intervening between there and the cabin can produce no false signal upon the repeater, but in case of either fault happening, a neutral (drooping) position will be shown on the instrument, unalter-

The arrangement is shown in figs. 1 and 2. The contact maker, A, is firmly fixed on the of the semaphore signal, and moves with it. four rubbing contact springs, L, C, Z, E, are statio and the whole is protected by a cover. With



able by the signal lever, and the signalman will learn thereby that the apparatus requires attention.

The second condition, economy of material, is attained by so arranging the connections that a single battery and one wire suffices for the three positions of the repeater—"on," "neutral," "off"—while a thorough rubbing contact is always insured.

semaphore arm "on," fig. 1, a copper current sent to line, with the arm "off," fig. 2, a current is sent. These currents produce corr ponding "on" and "off" signals upon the elec repeater, B, C. Intermediate (improper) positi of the semaphore signal by bringing the rubb springs upon the insulated parts of A, discon

the battery, the repeater drops to a neutral position, and the signalman seeing this, pulls or throws his lever over once more, and, if necessary, regulates the signal wire until a correct signal is shown.

The repeater instrument placed in the cabin, B, C, may be of any outward pattern, generally a miniature of the signal outside (and semaphores are now most common); it must of necessity contain inside an electro-magnet, magnetised needle, or both.

An ingenious instrument of the needle form has been introduced upon the London and South Western Railway by Mr. C. Goldstone, the Company's Chief Superintendent.

In this the needle is so balanced that with one current the small semaphore borne upon its axis goes to "on," with the reverse current it goes to "off," and with no current it falls diagonally.

The selection of the battery for this particular work is of importance. To be economical in maintenance it must be capable of supplying a constant current for considerable time without attention, the more so as it is at a distance from the station. Further, its solutions must have a low freezing point, or they will become solid and inert in severe winter weather.

These conditions I find fulfilled in the "Howell" cell.* Its e. m. f. is very high, about 2 volts, so that few cells are necessary, and compactness is gained. Its solutions only congeal at about 5° Fah., a temperature not likely to be reached inside its case, and it will last on constant current through the repeated resistance for ten or twelve weeks, and sometimes longer.

LIGHT REPEATERS.

After various trials in this direction I have found the form shown in fig. 3 the most successful of my attempts. It is very simple, cheap, and has the peculiarity of providing a superabundance of direct movement for making and breaking contact without the intervention of any auxiliary aids for multiplying the actual lineal expansion of the metals employed, and this peculiarity insures a strong rubbing contact, desirable in all cases, but above all where the contact points are subjected to heat. The arrangement consists of two bimetal straps (brass and steel) joined at one extremity, *a*, fig. 3.

The lower one next to the burner has its steel facing downwards. The upper one has its steel upwards.

The heat of the lamp flame produces a curvature of the compound metal straps, causing them to fly apart at their free end. And this movement is further greatly increased by the tilting of the upper strap as it follows the motion imparted to it by its attachment to the lower.

So considerable, indeed, is this motion with a moderate amount of heat that a flexible tongue, *c*, set back on the upper strap is necessary to relieve the strain upon cooling, while at the same time it produces the rubbing contact alluded to, and affords means of regulating the time of make and break to such nicety that the signalman may be warned of an insufficient light requiring trimming, or gas, even without its total extinction.

The apparatus in the cabin for calling the signalman's attention consists of the battery and a trembling bell with indicator, showing "light in" and "light out," the former by gravity when the circuit is broken at the lamp (fig. 3), the latter by the current which simultaneously rings the bell when, on cooling, the circuit is completed by contact being made with earth at the lamp (fig. 4).

During the day the battery is disconnected and only brought into circuit by inserting a peg at lighting-up time, and the signalman can always test the apparatus by inserting this peg before the metal straps break contact.

* See TELEGRAPHIC JOURNAL, December 1st, 1879, page 388.

ELECTRIC INDUCTION BY STRESS.

By S. W. ROBINSON, Professor of Physics and Mechanical Engineering, Ohio State University.

JOULE has shown that when a bar of iron is magnetised by means of a helix and electric current the bar is elongated appreciably. These elongations have been measured by Prof. E. A. Dolbear.

While undertaking some experiments in December, 1878, it occurred to me that the inverse of this ought to be true, namely, the forced elongation of a bar of iron, surrounded by a helix, would give cause for an electric current through the helix and connections. A series of experiments followed which completely verified the supposition, a recital of which may be of interest. The publication of them was deferred from time to time in the hope of more varied experiments, and in the possible discovery of like experiments by others.

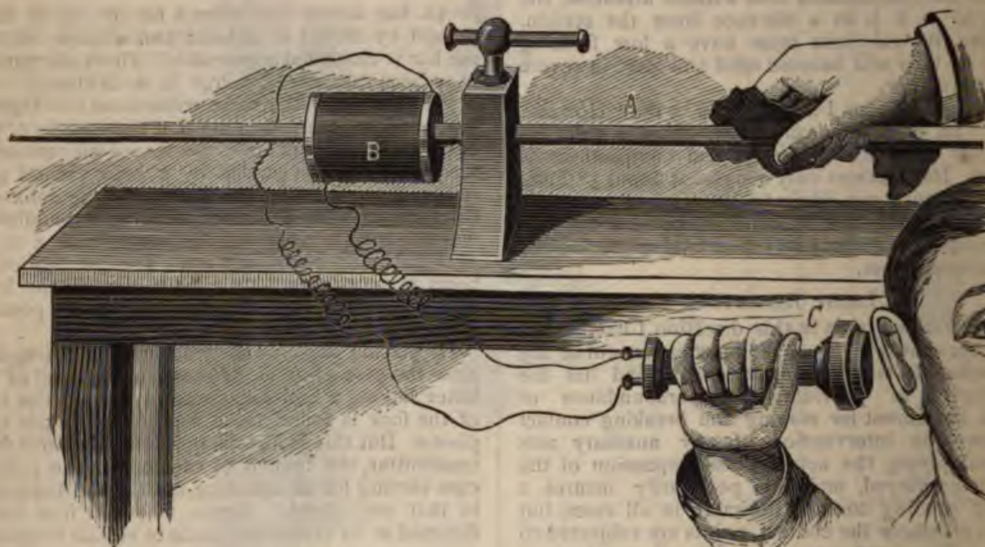
By placing one branch of a sounding tuning-fork near the pole of an electro-magnet, the coil of the latter having a Bell telephone in circuit, the tone of the fork is found to be reproduced in the telephone. But this is like using a Bell telephone for a transmitter, the branch of the fork in the present case serving for an armature, as does the diaphragm in that instrument. Again, when an iron bar is fastened at its centre and made to vibrate longitudinally near an electro-magnet, a telephone in circuit will speak, and for the same reasons as before. Remove the core of the magnet and the sound is still heard at the telephone, and it is not necessary that the bar be a magnet. Bars of iron were selected that possessed a minimum amount of magnetism, in fact an almost inappreciable magnetism, and still a loud sound was emitted by the telephone.

The helix used had no iron about it when the core was removed, and the opening for the core was large enough to encompass the bar without touching it. The bars used were several times the length of the helix.

At first it was supposed that the *motion* of the iron longitudinally was chiefly concerned in the production of sound. On this supposition the sound would diminish as the helix was moved toward the middle of the bar where it was firmly secured in a clamp for longitudinal vibration. But instead of this, the intensity was increased, and to such an extent that the auditor at the telephone in a distant room could positively say whether the

coil was at the end or at the middle of the longitudinally vibrating bar. This made it clear that the sounds observed were not to be explained altogether on the ground of vibratory motion of the particles of the bar, because the motion of the bar at its middle is *nil* when clamped at this point and vibrating longitudinally at its fundamental, while at the ends we have a maximum degree of vibratory motion. But at the middle of a bar thus conditioned we have a node, and the strains are here known to be those of extension and compression and at a maximum for the bar, while at the ends, the alternating strains are *nil;* that is, where the motion is greatest the strains are least, and *vice versa*. It seems, therefore, certain that at the middle the sound is chiefly due to the vibratory stresses, while at the ends it is almost entirely due to motion.

The engraving shows the apparatus. Rods were used which were from one-quarter to one-half inch in diameter and three feet long. The coil was about three inches long, and so connected with the free circuit wires that it could readily be moved along the rod. As the clamp prevented placing the coil exactly at the middle of the bar, the latter, to test this point, was taken out and suspended by two filaments so light as not to interfere with the vibration, and the bar made to vibrate longitudinally by striking on the end with a mallet. The coil was placed directly at the middle and also shifted to right and left, but the sound was still loudest at the middle. Sounds produced by the transverse vibrations, now accidentally occurring and mixing with those due to the longitudinal vibrations, were heard, but were readily distinguished by the pitch of tone. These were separated from the above consideration of longitudinal vibrations.



To further test the matter of electric induction by stress, a rod was passed through the coil, and the rod put under tension in a testing machine. A galvanometer now placed in the circuit became very active as the strain was put on. The bar was an ordinary three-eighths rod of commercial bar iron. It was at once found to be permanently stretching, and the galvanometer needle was all the while flying about as the extension continued. When the bar was removed, it was found to be strongly magnetic, much more so than it could have been when put in. It was also heated. It therefore seemed difficult to determine whether the observed currents of electric induction were due to strain, stretch, magnetism, motion, or heat, in part or together.

A piece of white chilled cast iron was then tested to 42,000 lb. compression, and found to resist the full power of the machine without crushing or set. The coil was then placed around the rod, and the test for stress-electric induction applied. Under compressive strains the needle gave unmistakable evidence of electric currents, though they were much feebler than in the previous case of soft iron.

Experiments on steel bars, not magnetised, gave appreciably the same effects as iron bars. Magnetised steel was not tried, but it is presumed that at the end of the bar magnet vibrating longitudinally the sounds would be intensified, while at the middle of the bar, normally magnetised, the sounds probably would not materially differ from those obtained from non-magnetic bars.

A few other metals were tried, copper and brass particularly, but no sounds were heard from them. These experiments, though far from being complete and exhaustive of the subject, warrant us in the following conclusions, namely :—

1st. That the fact of Joule, of the distortion of bars of iron by magnetisation with electric currents, is operative in the inverse order, namely, distortion of bars by mechanical force induces electric currents in surrounding coils.

2nd. Most other metals than iron or steel give but feeble if any observable results of stress-electric induction.—*Scientific American.*

Reviews.

Electrotyping, a Practical Manual. By J. W. URQUHART, C.E. London: Crosby Lockwood & Co.

THE art of electrotyping, as distinct from electroplating, has now become an important industry, and, like other branches of manufacturing art, it requires a manual to explain to the rising generation what processes are involved in carrying on the work of the electrotyper. The book before us is certainly a good attempt to supply a real want. Following the usual fashion, Mr. Urquhart has attempted in the introduction to give some explanation of the theory of the electric battery, the meaning of the various electrical units, &c. Such matter is, we think, of but very little, if any, practical value to those who are likely to study the book. Those who wish to get a clear insight into the whole of the principles involved will certainly not be much enlightened by descriptions which, to be of real value, cannot but be lengthy. But although much of the matter in the introduction might have been left out without injury to the book, still there is a good deal which could be read with great advantage, and which is an indication that the author is quite at home on the subject he treats of.

In the chapter on sources of electricity Mr. Urquhart gives very many most useful hints with reference to the construction of batteries, and he points out with reference to the battery which is a very favourite one with amateurs, namely, the Smee, that its usual construction is anything but a good one. Philosophical instrument makers, it must be admitted, are not, as a rule, very happy in the designs of the instruments and batteries they supply, as amateurs often find to their cost.

It seems somewhat curious that the Smee, which is by no means a constant battery, should have proved to be such a favourite one with electrotypers. The Daniell, it seems, has not found so much favour as its constant properties would appear to warrant. In speaking of the Daniell battery many thoroughly practical and useful hints are given with reference to the proper arrangement and maintenance of the cells. It is wonderful what a difference a little attention to such hints will make in the working of a battery.

Speaking of the bending of battery zincs, Mr. Urquhart states that if the latter be heated by being plunged into boiling water they may be easily curved and bent to the required shapes. This is certainly a very useful fact to know, and one which may save a great deal of trouble.

The thermo-electric battery seems eminently suitable for electrotyping and electro-plating purposes. Nearly all those hitherto tried have, however, failed in their action eventually. The principal cause of this has, we believe, been due to the fact that the piles have been subjected too often to alternations of heat and cold, which has "racked" the junctions of the dissimilar metals and caused eventual disconnection faults. If the piles were kept continually warm they would probably last for an indefinite period, and would prove very economical, in spite of the comparatively large consumption of gas which would be required to keep up the continual heat. The thermopile is certainly *par excellence* a *clean* source of electricity.

The "safety current interrupter" invented by Mr. Urquhart, and used for the purpose of preventing the reversal of the current which might take place when the latter is generated by a dynamo machine, is certainly as simple and as effective an arrangement as could be desired.

The chapters of the book on "Solutions," "Depositing and Moulding Apparatus," "Preparation of the Work," &c., are written in a very practical manner, and give such details as are very essential to insure success. Altogether we must confess that the book is an excellent addition to the growing list of electrical works, and is by no means a merely ornamental volume. It is one which every one who wishes to know about electro-plating should purchase.

Electricity. By FLEEMING JENKIN, F.R.S. London: Society for Promoting Christian Knowledge.

PROFESSOR JENKIN is so well known in the electrical scientific world that any book from his pen must command popularity. The task of writing the treatise must have been a somewhat difficult one, considering that there are but 120 small pages of matter, and that the subject treated of is of such vast extension. Altogether the information given has been judiciously chosen, although the work by itself is hardly one which could with advantage be put into the hands of any one who commences to study the subject for the first time.

Book Received.

A Handbook of Electrical Testing. By H. R. KEMPE. New edition, revised and enlarged. E. and F. N. Spon, London.

Notes.

ON THE INFLUENCE OF TEMPERATURE UPON SELENIUM TELEPHONIC RECEIVERS.—M. E. Mercadier concludes from experiments undertaken that radiophonic receivers, constructed of selenium, tend more or less rapidly to a state of stability relatively to the effects of temperature. At ordinary temperatures, and even up to 100° C., the resistance of these receivers varies inversely as the temperature between 5° or 6° to 35°, these variations may be considered approximately as mutually proportionate.

ON THE THERMIC LAWS OF THE EXCITING SPARK OF CONDENSERS.—By M. E. Villari.—The author terms the "exciting spark" of the discharge of a condenser that which is produced against the exciter, whilst he names that which is formed in an interruption the "conjunctive spark." The properties of the latter he has explained elsewhere. To study the heat of the exciting spark he has constructed an "exciter thermometer," which consists of an exciter inclosed in a glass globe. By means of two tubulures this globe

was supported by two bands of ebonite, upon which it could turn around a horizontal axis and close the circuit of a battery to which it was connected at the moment of the discharge, the spark bursting in the balloon. The heat developed was measured by the displacement of an indicator of glycerine and water contained in a vertical tube of glass attached to the globe. On experimenting with this apparatus for different charges communicated to one and the same battery, he has found as a mean result, and within the limits of his researches, that the heat developed by the exciting spark alone is approximately proportional to the square of the charges. This law is not general, for the experiments are complicated by various phenomena. The glass of the jars does not always retain electric charges well, and jars are met with which cannot be charged. It is necessary to select jars and to coat them with a good lac varnish.

Further, he has found when experimenting with high potentials that energetic interior discharges are produced in the jars, and there is a development of heat to the detriment of that which accompanies the exterior exciting spark.

He has also remodelled his thermometer, and on repeating his experiments has obtained concordant results which may be summed up as follows:—

1. The heat of the exciting spark increases more rapidly than the third power of the charges for a small potential.

2. For a medium potential it increases as the squares of the charges.

3. For a very high potential it increases as the charges.

It is probable that account should be taken of the influence of internal discharges. They are very small for small potentials, but increase very rapidly as the potential is augmented.

He has also studied how the heat produced by the spark varies with the quantity of electricity, the potential remaining constant. He finds that the heat of the exciting spark alone grows a little less rapidly than the charge when the potential is constant. More exactly when the charge increases from 1 to 2, the heat produced rises from 1 to 1·77.

He has also caused the potential of a constant charge to vary, accumulating it in a variable number of bottles, and has proved that the heat of the exciting spark alone increases:

1. More rapidly than the potentials, if they are small.

2. As the potentials, if they are medium.

3. Much less than the potentials, or even decreases if the latter are very high. These different effects are also affected by internal discharges. In case of small potentials, he finds that on increasing the potential from 1 to 2 (12 of the electrometric charges being at first distributed in 24, and then in 12 equal jars), the heat of the spark increases in the ratio of 1 to 3·81.

To sum up, it may be said that for small potentials, when in a condenser, the charge and the potential are made to increase at the same time and in the same proportions (as occurs when the electric mass is augmented in one and the same battery), in the ratio of 1 to 2, the heat of the spark should increase, according to the foregoing results, in the proportion of $1 : 1{\cdot}77 \times 3{\cdot}81$, that is $1 : 6{\cdot}74$. If we know the heat developed by the spark of charge 1, we may determine, in this indirect manner, and the heat determined by a charge 2 accumulated in the same condenser.

The author's experiments show a complete agreement between the quantity of heat, as determined by direct measurements and as calculated by the indirect method.

The law of the surfaces of condensers is evidently intimately connected with that of the potentials; thus the same three cases which have been indicated for the laws of potentials will be distinguished for surfaces.

From the foregoing it results that for a determined potential of a given charge the heat developed is divided between the internal spark and the external "exciting spark" in such a manner that in the latter it augments proportionally to the squares of the charges, and in an inverse ratio to the surface of the condensers.

These laws, which may be named the limiting laws of the spark, are the same as those which apply to metallic wires. It may thus be said that:

The heat developed by the spark is proportional to the quantity of electricity multiplied by the electric density, or it is proportional to the quantity of electricity for the fall of the potential.

A part of the spark may be replaced by a metallic wire, and *vice versa*. It is necessary that the sum of all the other effects produced by the spark should follow the same laws.

There is, however, an essential difference between the spark and the wires, as far as thermic phenomena are concerned. The spark increases both in length and section in proportion as the charges and the potentials increase. It may, therefore, be regarded as a variable conductor, in which the heat may be a function of the number of the component gaseous molecules, and perhaps of their temperature.

In metallic wires, which may be regarded as fixed conductors, the thermic power is an exclusive function of the temperature.—*Comptes Rendus.*

M. GASTON PLANTÉ writes to us to say that it is not his intention to establish works for the manufacture of his secondary couples, as was stated in our last issue; these couples have been constructed for some time past in the workshops of M. Breguet. It is also a mistake to suppose, as has been stated, that the modification of the Planté couples, made by M. Faure, cannot be charged by dynamo-electric machines, whilst the ordinary form can. M. Planté says simply that magneto-electric machines do not answer as well as batteries for the charging of his couples, either prepared or unprepared, as, in consequence of the inequalities of the electro-motive force of the current given by the machines, a portion of the charge taken can discharge itself proportionally in the circuit of the machine when the electro-motive force of the latter falls below a certain point. M. Planté thinks, nevertheless, that it would be more advantageous to store up the electricity of machines than of batteries, now that voltaic electricity is produced by mechanical work in greater quantity, and with greater economy, than by chemical action. (For a full illustrated description of the Planté battery see TELEGRAPHIC JOURNAL, Dec. 1st, 1875.)

IN the House of Commons on the 8th inst. the Attorney-General, in answer to a question put by Sir H. Tyler as to the responsibility of local authorities for the safety of the public as regarded casualties from the fracture of the telegraph wires stretched over the public thoroughfares, said that by the Act of 1863, sections 9, 10, and 12, telegraph companies were restrained from placing posts and wires along thoroughfares without the consent of the body having control of such thoroughfares. By the Act of 1868 the Act of 1863 was made to apply to the Postmaster-General. So this Act only restrained telegraph companies and the Postmaster-General; but in relation to other public bodies and to private individuals placing posts and wires along the public thoroughfares, the responsibility of seeing that they were placed properly, and did not cause danger to the public, rested with the body having the control of

eets and highways. In the opinion of the ıment nothing had arisen to render necessary a nental inquiry with a view to avoid the risk to ı using the thoroughfares under the telegraph If any wire were erected to which the local ty took exception on the score of danger to the they could restrain the Postmaster-General in tter.

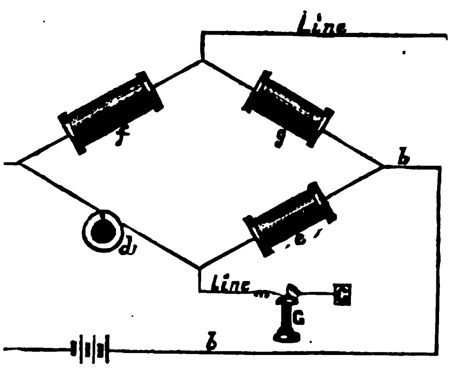
MAJESTY'S GOVERNMENT have appointed the Crawford and Balcarres Chief Commissioner, r Charles T. Bright, Professor D. E. Hughes, and Lieutenant-Colonel C. E. Webber, R.E., as ssioners, at the forthcoming Electrical Exhibi- d Congress at Paris.

ccordance with a resolution unanimously passed ıeeting of the British exhibitors at the Paris cal Exhibition, subscriptions towards a gua- fund for the *decoration*, *maintenance*, and *service* British section were invited. A considerable ıs already been subscribed.

Weston Company has commenced an action : the Brush Lighting Companies in the United for an alleged infringement of patent. The s for one of the most important features of the system.

tramcar recently tried in Paris was driven by ıure accumulators, the cost of the latter being and weighing a ton and a quarter.

combination of Wheatstone bridge in a battery- with a transmitter placed in one of the arms of dge, and a main line which forms the cross-wire bridge, and a receiver placed in the main line,



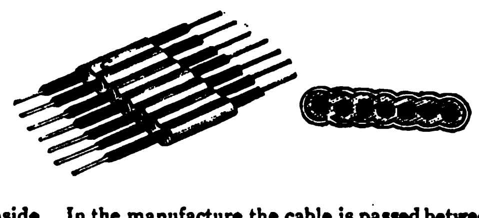
is shown by the figure, has recently been patented United States. (Patent No. 243,311, dated April :881.)

STEM of lighting and extinguishing gas lamps by atic action is now under trial in Sheffield. The is the invention of Mr. G. Weston.

ARGE ELECTRO-MAGNET.—MM. Von Feilitzsch . Holtz have recently made, for the University of wald, an electro-magnet of enormous dimensions. ice of a bar of iron made in one single piece have been too expensive, whilst on the other n a system formed of several pieces, poles be- leveloped at the contacts. The electro-magnet was, therefore, constructed of 28 plates of iron, 7 millimetres thick, bent into a horseshoe shape, and of a size such that their combination forms a cylinder 195 millimetres in diameter. These plates are varnished, in order to avoid the formation of extra currents; they are connected together by iron bands, and so arranged as to form a cylinder of uniform diameter. The total height is 125 centimetres, the distance between the poles 596 millimetres; the total weight 628 kilogrammes. The magnetising helix is composed of 100 kilogrammes of plates of copper, forming 15 layers, insulated from one another by gutta percha. Outside there are 175 kilogrammes of wire, 2 millimetres thick, forming 5 double layers of wire, and the extremities of the different parts of the circuit communicate with terminals fixed on insulated columns, which allow of any required connections being made. The poles are topped with two plates, 33 millimetres thick, which can be set at any required distance apart, and are capable of carrying various accessories. A movable plate, placed between the two branches, can be placed at any convenient height for the experiments. With this apparatus, excited by 50 small Grove cells, it was possible to melt in two minutes 40 grammes of Wood's metal by Foucault's experiment, and if the poles were set close, the resistance stopped the movement in spite of the tension of the driving band. It is very easy to show the rotation of the plane of polarisation in heavy glass, when the latter is traversed by a ray of light, &c. In this apparatus, as has been pointed out, the bar of iron weighs 628 kilogrammes, and the wire 275 kilogrammes, whilst in the one constructed by Plücker, and which was the largest existing, the weights were only 84 and 35 kilogrammes respectively.—*Les Mondes.*

DR. OLIVER J. LODGE has been appointed to the Lyon-Jones Professorship of Experimental Physics and Mathematics by the Councils of University College, Liverpool, and of the Liverpool Royal Infirmary School of Medicine.

A PATENT for an electric cable (No. 242,894, dated May 9th, 1881), has recently been taken out in the United States by Mr. Patrick Delany. The cable, which is shown by the figure, consists of a lead tube flattened out, and containing insulated wires inserted



inside. In the manufacture the cable is passed between corrugated rollers, which press the lead close around the insulated wires. The lead tube is connected to the ground, and at junction the wires are crossed to avoid induction.

BELGIUM will take a considerable share in the forthcoming Paris Exhibition. The number of exhibitors is over a hundred. Among other exhibits the Jaspar regulator and the *lampe-soleil* of MM. Clerc and Bureau will compete prominently with the numerous other systems of electric lighting. Of telephone specialists M. de Locht-Labye will show his pan-telephone in action, and M. Navez's researches will doubtless

receive due attention. Meteorological instruments will be specially represented by those of M. Van Rysselberghe, with which the indications of a meteorograph at a distance are registered directly at Brussels Observatory. Colonel Leboulangé will exhibit ballistic apparatus of special type, and his ingenious dronometer and dromoscope for controlling the velocity of trains, especially at dangerous points. Various kinds of telegraph wire will be shown, and a special interest will attach to the wires of phosphor bronze from the works of M. Montefiore Lévy; these wires have a conductivity four times that of iron, and their tenacity being also much greater, lines may be made in which the wire section is greatly reduced. An official and special catalogue is being prepared for the Belgian section; it will comprise an introductory notice by M. Bonneux on electrical science and industry in that country.—*Nature.*

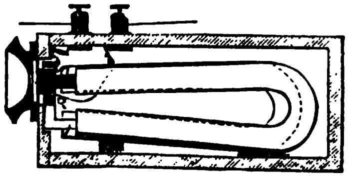
FROM experiments made by Herr Muraska, it appears that graphite conducts the best of any variety of carbon, whilst its resistance varies the greatest by variation of temperature. It is thus thermo-electrically negative to all known varieties of carbon.

THERE are now nearly 150 offices connected by telephones in Hamburg.

THE s.s. *Chateau Leoville*, built for a French company, and recently launched at Sunderland, is to be fitted with the Swan incandescent lamp.

THE French Minister of Postal Telegraphy recently sent to the several telegraphic offices forms for recording all the observations connected with thunderstorms. The forms have been drawn up by M. Mascart, the head of the Meteorological Office, and printed at its expense.

THE telephone shown by the figure has been patented (No. 242,816, dated Nov. 28th, 1877) in the United States by C. Cuttress and J. Redding, assignors to J. Wentworth Brown and H. Hyde. The arrangement



consists of a tympanum or plate rigidly supported at its edges, but free to vibrate at its centre, with a hollow cylindrical helix of insulated wire mounted axially upon the tympanum.

MR. EDISON has patented (No. 242,896, dated Dec. 15th, 1881) the incandescent lamp shown by the

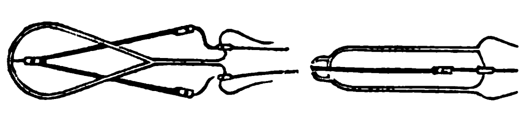


figure. The novelty of the arrangement lies in the combination, with the incandescing loop of an electric lamp, of a support arranged to maintain the carbon loop in its normal position.

THE time-ball recently erected at Kansas City, and which is dropped as a part of the time service of the Morrison Observatory, is the first attempt in this direction in the West. It was paid for chiefly by an appropriation of the City Council of that city. The site selected was the large building just erected by the Messrs. Bullene, Moores & Emory, on Delaware Street. The ball when raised to the top of the staff is about 140 feet above the street, and is generally visible to the business portion of the city. The ball, which passes over the staff, is simply a wire skeleton covered with canvas and painted black, and is about three feet in diameter. It was loaded on the inside with lead until it was found to drop instantly and without loss of time. It has a drop of about twenty-five feet and is slowed up as it reaches the bottom, and is received upon a set of tall springs surmounted by a stout cushion. The apparatus by means of which the ball is dropped at precisely the right instant was constructed under the direction of Mr. W. F. Gardner, the instrument maker of the Naval Observatory at Washington. It is of a very simple form, and is found to answer all requirements. This has been found to work easily and without loss of time, and can scarcely get out of order. The entire cost of mounting the ball and machinery was only about 120 dollars, and with this small amount it was necessary to use the utmost economy in the purchase of materials and apparatus. Kansas City is about one hundred miles from the Observatory, and except in cases of breaking of the wire, when the ball cannot be dropped at all, it is dropped within one or two-tenths of a second of correct time.—*Science.*

THE United Telephone Company has just concluded an arrangement with the Postmaster-General, under which three of the Company's principal Exchanges will be at once connected by the telephone with the Telegraph Department at St. Martin's-le-Grand. Each subscriber to the Company's Exchanges will thus be placed in immediate and direct communication with the Post Office, and will be able to transmit messages through the telephone direct to the Central Telegraph Office, whence they will be delivered within a short radius of St. Martin's-le-Grand, or forwarded by telegraph to other parts of London or the United Kingdom.

THE Anglo-American Telegraph Company announce that the Brest-St. Pierre cable laid in 1869, which was broken on the 12th November last, has been picked up in 1,700 fathoms of water and repaired. As a consequence, telegraphic communication between France and the United States of America by this Company's cable *via* Brest has been restored.

LA COMPAGNIE FRANÇAISE DU TÉLÉGRAPHE DE PARIS À NEW YORK.—Some very interesting statements respecting this company have recently been published in *Truth*. We would refer those of our readers who are desirous of obtaining them to the issues of that paper for June 23rd and 30th, and July 7th.

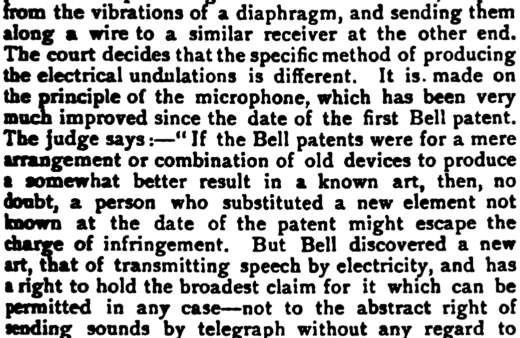
THE electric lights in Cheapside, says the *Daily News*, as far as Queen Street, St. Paul's Churchyard, Ludgate

Hill, Bridge Street, and Blackfriars Bridge—that portion of the City served by the Brush system—failed on Sunday night last, and recourse had to be made to the gas lamps.

THE United States Circuit Court, on June 27th, Judge Lowell, rendered a decree for the complainants in the suit of the American Bell Telephone Company *et al* v. Albert Spencer *et al*. This was a bill in equity alleging infringement of two patents granted to Alexander Graham Bell. The defendants admitted that they had infringed some valid claims of the second patent, but the plaintiffs have given them no evidence of such infringement. They rely entirely upon the fourth claim of the first patent, which is much more comprehensive in its scope. This claim was that the defendants are using a method and apparatus for transmitting vocal sounds which resemble those of the plaintiff in producing electrical undulations, copied from the vibrations of a diaphragm, and sending them along a wire to a similar receiver at the other end. The court decides that the specific method of producing the electrical undulations is different. It is made on the principle of the microphone, which has been very much improved since the date of the first Bell patent. The judge says:—"If the Bell patents were for a mere arrangement or combination of old devices to produce a somewhat better result in a known art, then, no doubt, a person who substituted a new element not known at the date of the patent might escape the charge of infringement. But Bell discovered a new art, that of transmitting speech by electricity, and has a right to hold the broadest claim for it which can be permitted in any case—not to the abstract right of sending sounds by telegraph without any regard to means, but to all means and processes which he has both invented and claimed."—*Operator*.

SCHUCKERT'S DIFFERENTIAL RING-LAMP.—This lamp, for which Sigmund Schuckert, of Nurnberg, has taken out a German patent (No. 13,619), is in principle an electro-magnetic machine, through which, while burning, two currents constantly pass, tending to

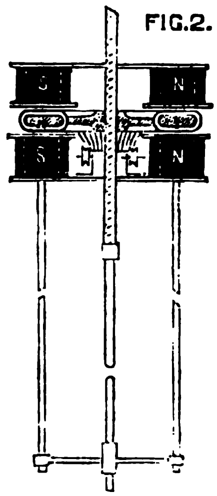
FIG. 1.



turn a rotatory inductor in opposite directions. One of these is the main current which passes through the luminous arc, whilst the other is introduced as a branch-current and does not traverse the arc. As is shown in diagram fig. 1, the current is introduced by the pencil at a into the ring-inductor, from which it issues again at a^1. Here it is divided, one branch (the main current) passing to the electro-magnets, S and N, and through the luminous arc back to the machine, the branch-current flowing through the electro-magnets, N^1 and S^1, and returning from here direct to the machine. The coils and the resistances of the branches, S, N, and S^1, N^1, are so arranged that for a given magnitude and a corresponding resistance of the luminous arc, the magnetic actions of both upon the inductor are in equilibrium. If the resistance of the luminous arc is modified, the resistance of the circuit of the main current is affected correspondingly, and according to the increase or decrease of this resistance the magnetic action of the by-current and of the main-current upon the ring-inductor predominates.

Schuckert carries out this principle in various constructions, one of which is shown in fig. 2. The induc-

FIG. 2.



tor, which here takes the form of a flat ring, carries a female screw, into which the upper carbon-holder, provided with a screw-thread, is introduced. As the ring, according to the ratio of resistance between the main current and the by-current, is affected by one or the other, the carbon-holder moves upwards and downwards, and thus the magnitude of the luminous arc is regulated, independently of the total strength of the current. This internal regulation of the lamp permits the introduction of several lamps in one common circuit.—*Electrotechnische Zeitschrift*.

THE *Standard* says:—"Numerous complaints reach us as to the frequently recurring inaccuracies in the Stock Exchange prices impressed upon the tapes of the Exchange Telegraph Company. The inconvenience caused to stockbrokers in consequence is considerable, clients at a distance constantly calling their attention to discrepancies between the tape figures and those at which business is actually transacted." This, we presume, means that the apparatus is defectively adjusted. We do not recollect having heard of any complaints before, although the system has been at work for several years.

THE arrival in the Thames of a steamer from the Clyde steered by electric apparatus has excited much

attention in scientific circles. The experiment was highly successful with one important exception, which does not appear to be generally known. The electric apparatus steered the ship, but it so eccentrically affected the compasses that they were of no use. We are not aware from what cause this peculiar effect arose, but there seems no reason to suppose that it cannot easily be overcome.

The Western and Brazilian Telegraph Company (Limited).—A supplementary report has been issued by the directors of this company with reference to the actions in progress for the recovery of large sums of money alleged to have been improperly expended in the promotion of the company. It would appear that, as has all along been expected, offers of compromise have been received. The directors say that "they have good reason to believe that a compromise of these actions, as against the great majority of the defendants, can be effected, whereby the company will receive a sum of £100,000 in cash and £110,000 nominal in shares, with liberty to the defendants to substitute for the latter the fixed sum of £8 per share, and reserving the rights of the company as against the remaining defendants, the company defraying its own expenses, and conceding to the liquidators of Hooper's Telegraph Works (Limited) one moiety of such portion of the assets of the Central American Telegraph Company (Limited) as may be agreed or determined to belong to this company in respect of their claim upon the Central Company. The directors are unanimously of opinion, having regard to all the circumstances, that it will, in the interests of the company, be expedient to make such a compromise."

The Eastern Telegraphic Company notify the interruption of their Aden-Bombay cables near the shore at Bombay. Until they are restored telegrams for India, China, Australia, &c., should be sent by the lines of the Indo-European Telegraph Company.

At the ensuing meeting of the India Rubber, Gutta Percha, and Telegraph Works Company (Limited), the directors will recommend the distribution of an interim dividend of 10s. per share, free of income tax, being at the rate of 10 per cent. per annum.

Correspondence.

CONTACT-TELEPHONE OR MICROPHONE TRANSMITTER.

To the Editor of The Telegraphic Journal.

Sir,—I notice on page 259 of the Telegraphic Journal for the 1st inst. that M. Emile Berliner claims to have been the original inventor of the contact-telephone or microphone. I therefore venture to inform you that I made and had a transmitter (similar to that shown in the diagram accompanying the description of M. Emile Berliner's contact-telephone) in use experimentally as early as November, 1878. My transmitter was described in the *Somerset County Gazette* of November 19th, 1878, as follows:—

"The instrument consists of a diaphragm made of ferrotype plate fastened in a vertical position. In the centre of the diaphragm a piece of carbon is secured. The base of the carbon is against the back of the diaphragm, and its point rests lightly against another piece of carbon, which is fixed on the top of a brass spring. There is a screw in the rear of the spring for adjusting purposes. This simple instrument, when connected to a telephone and battery, will transmit articulate and other sounds very distinctly."

Yours obediently.

F. T. J. HAYNES.

Taunton.

July 4th, 1881.

P.S.—Can you kindly furnish me with the date of the first patent taken out for carbon transmitters?—F. T. J. H.

[Berliner's first patent was applied for on April 4th, 1877. For further information on the subject, we would refer you to the third note on page 406 of the Telegraphic Journal for Dec. 1st, 1880.—Ed. Tel. Jour.]

IMPROVED ELECTRO-MOTIVE ENGINE.

To the Editor of The Telegraphic Journal.

Sir,—In answer to your correspondent, "Volt," regarding the motor I described at p. 229, it will be well to premise that the term one man-power is very indefinite and indeed unsatisfactory, since no one knows what a man-power is unless we assume it to approximate somewhat to the sixth-part of a horse-power—that is, 5,500 foot lbs. in a minute. This energy the motor described will not exert. Its limit of power is, probably, less than one-fifth of this—that is, 1,000 foot lbs., with three of my sustaining cells, as described. Since the resistance of both armature and field magnet is low, an electro-motive force of about six volts at the seat of generation of current suffices to give a great velocity to the armature, and this e. m. f. is obtainable by the use of three cells. As to their size, plates presenting an active surface of about 60 square inches—say plates, 6 by 5—will suffice. As a matter of course, if it be desirable to have at command a greater mechanical power than that mentioned, both engine and generator must be enlarged. As to the cells, I have been improving them, and can now, from cells of the same bulk as I before used, obtain a sustained current for double the time without any attention. With a cell or containing vessel as already described, capable of containing one gallon of liquid, I can obtain a constant current for six or eight hours at a time. I shall endeavour to offer constructional particulars of the new cell.

A.

New Patents—1881.

2823. "Secondary batteries." A. P. Laurie. Dated June 28.

2826. "Electric fuses." D. Johnson and E. Spon. Dated June 28.

2833. "Improvements in electric incandescent lamps and in burners for same." G. G. André and E. Easton. Dated June 28.

2846. "Apparatus for transmitting sounds by means of electricity." E. J. Paterson. Dated June 29.

2848. "Treatment of carbon for electric lighting and)ther purposes." J. G. LORRAIN. Dated June 29.

2851. "Electric lighting apparatus." W. R. LAKE. (Communicated by J. J. Wood.) Dated June 29.

2867. "Telephonic apparatus." W. E. POTTER. Dated July 1.

2879. "Improvements in railway signalling and in apparatus for effecting the same by electricity." E. TYER. Dated July 1.

2930. "Electric lamps." E. P. WARD. Dated July 5.

2943. "Electro-magnetic motors." S. PITT. (Communicated by M. G. Farmer.) Complete. Dated July 5.

2944. "Manufacture of electric telegraph wire ropes or cables." J. P. HOOPER. Dated July 5.

2954. "Magneto or dynamo-electric machines or electric engines." P. JENSEN. (Communicated by T. A. Edison.) Dated July 6.

2986. "Telephonic signalling and commutating apparatus." J. IMRAY. (Communicated by C. Ader.) Dated July 7.

2988. "Improvements in telephonic apparatus, part of which improvements is also applicable to other electrical or magnetic apparatus." G. L. ANDERS. Dated July 7.

2989. "Apparatus for the transmission of power by electricity." J. HOPKINSON. Dated July 7.

2995. "Telephonic and telegraphic signalling apparatus." A. C. BROWN and H. A. C. SAUNDERS. Dated July 7.

3015. "Improvements in electric lighting apparatus, which invention comprises mechanism applicable for other purposes." W. R. LAKE. (Communicated by J. J. C. W. Greb.) Dated July 8.

3032. "Improvements in regulating electric currents, and in the apparatus or means employed therein." Sir W. THOMSON. Dated July 9.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1880.

4049. "Electric machines." A. W. L. REDDIE. (A communication from abroad by MM. A. Biloret

FIG.3.

FIG.1.

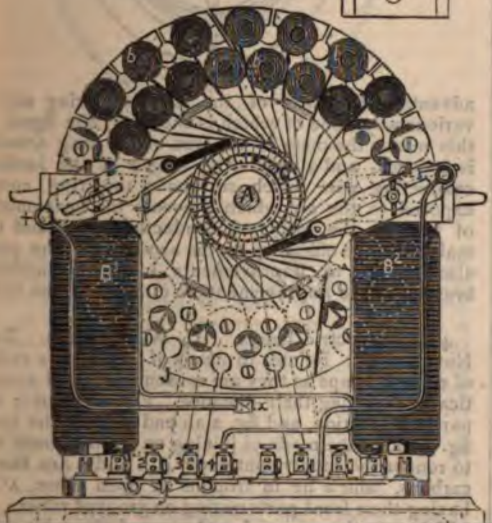
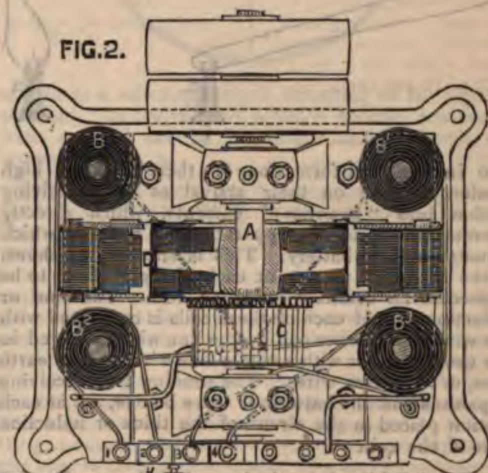


FIG.4

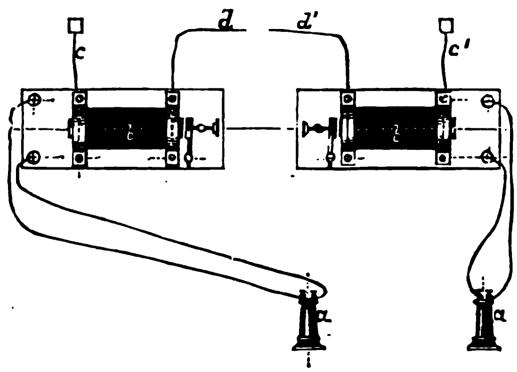
FIG.2.



nd C. Mora, of Paris.) Dated Oct. 5. 6d. In this vention the induced current in a dynamo machine is ssed round all the poles of the field magnets at once, d a current from each pole where the wire of that le comes out can be utilised, so that there will be four distinct currents with the Gramme or Siemens machines, which have four poles, and two currents with the Lontin machine, which has but two poles. The invention also relates to an improvement by which greater solidity is imparted to the armatures of dynamo or magneto-electric machines. Fig. 1 represents a front view partly in section of a dynamo-electric machine. Fig. 2 is a plan view of the same, also partly in section. *b*, *b*, are the induction bobbins, the cores of which are mounted between the two

cheeks or rings of iron, J, J^1, thus forming tie pieces, which give great strength to the armature, D, which armature is keyed to the axle, A, of the machine. B, B^1, B^2, B^3, are four bobbins constituting the field magnets, which are magnetised by means of the commutator, C, also keyed upon the axle, A. The inner ends of the wires coiled around these bobbins are grouped together at X, the outer ends being severally connected to the binding screws, 1, 2, 3, 4, fixed on insulated copper blocks. These copper blocks can be coupled together in pairs or otherwise by means of copper plugs, *y*, of which only one is shown in the drawing, as coupling the binding screws, 2 and 3. Thus the current will pass through two of the field magnets, and a stronger current is obtained than can be obtained from the binding screws, 1 and 4, each current in this latter case passing through one field magnet only.

4116. "Transmitting electrical currents through conductors," &c. W. R. LAKE. (A communication from abroad by Louis Maiche, of Paris.) Dated Oct. 9. 6d. Relates to an improved method of and means for transmitting and receiving electric currents, and is chiefly designed for facilitating the transmission and reception of telephonic or telegraphic messages or signals, whatever may be the kind or description of instrument employed as a sending or receiving apparatus. The invention consists essentially in transforming at the starting point "quantity" currents, of low tension (produced by the battery or other apparatus) into induced currents of high tension capable of overcoming the resistance of the line

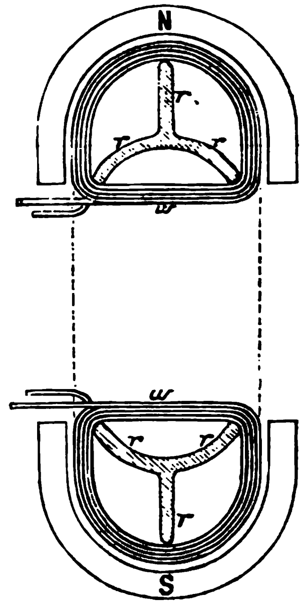


also in the transformation of these induced high tension currents on their arrival at the receiving station into "quantity" currents, which directly operate the receiving apparatus, or a relay which actuates a local battery. This is effected, as shown in the figure, by placing at each of the stations to be connected an ordinary induction coil. The fine or induction wire of each of these coils is connected with the wire of the other coil by the line wire arranged in the usual manner with a single line wire and an earth wire, or with two wires. The sending and receiving apparatus and the battery, if there be one, are at each station placed in the circuit of the thick or induction wire of the coil.

4482. "Cables for telephones." EDGAR GEORGE and JOSEPH BOND MORGAN. Dated Nov. 3. 6d. Relates to cables for overcoming telephonic induction. The wires are coated with an insulating substance in which wires are imbedded. The wires are connected to earth by conductors at intervals more or less distant as may be found necessary.

4581. "Telegraph receiving apparatus." WILLIAM FULLER. Dated November 8. 6d. I to the mirror galvanometer described on page the last number of this Journal.

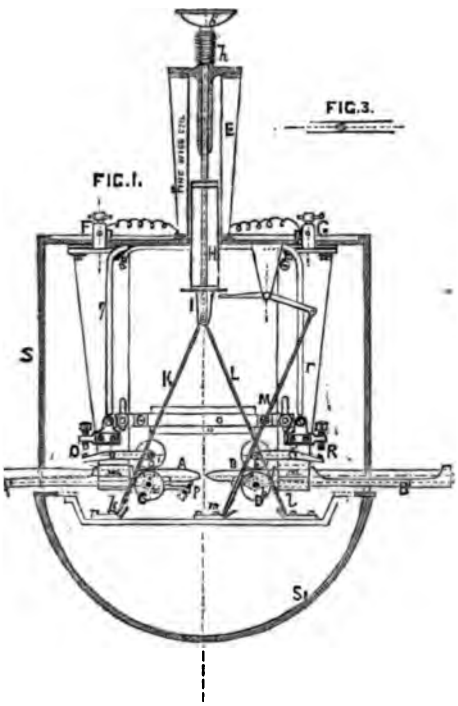
4608. "Generating, sub-dividing, and trans electric currents," &c. C. F. HEINRICHS. Nov. 9. 1s. 2d. The patentee finds that wl patent channeled ring armature is rotated at high velocity (say, at a velocity of over 10,0 circumferentially per minute) so as to obtain a of high electro-motive force, the iron core of t armature acquires little magnetism, and thu little part in the generation of currents in its su ing conducting wire. Hence he varies witl



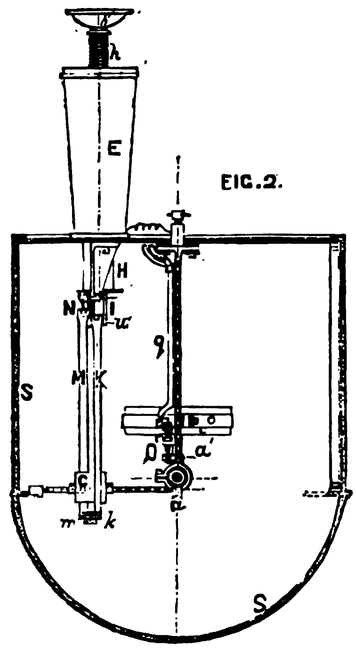
advantage the form of the channeled ring various ways, one of which is shown by the fig this means the mass of the iron of the ring a is reduced, and a very large length of the i conducting wire which surrounds the ring exposed to the air, which prevents the accun of heat in the insulated conducting wire, a maintains the efficiency of the armature. The also relates to improvements in the com brushes and to improvements in circular carbo

4614. "Electric lamps." C. W. SIEMENS. Nov. 10. 6d. Relates to means of feeding the of electric lamps as they are consumed, and of a tically adjusting their distance. Fig. 1 is a si partly in section, and fig. 2 an end view of the fig. 3 shows the mode of joining on fresh carbo to render the supply continuous. A and B are carbons, which lie in troughs or open tubes, having their front parts resting on grooved roll which may be serrated and pressed down by a^1, b^1, the weight of which may be aided by On the axes of the grooved rollers, *a*, *b*, ar wheels, C, D, which are finely serrated o peripheries or may have their peripheries clotl felt, soft leather, or other impressible material. solenoid coil of high resistance which forms p

ss circuit connecting the conducting posts, F and the main circuit of the lamp; H is the core of the oid, which is made as a thin iron tube for the f lightness, and is balanced or nearly so by a spring, ıstable by a screw cap, h^1. This cap is preferıade in the form of a cup, as shown, so that it more or less loaded by shot or other small heavy . In the double stem, I, projecting down from re, H, there are slots in which works a pin, i, g together two bars, K, L, which extend obliquely ards, and rest by their lower ends in saddle k, l, in which position their inner faces are just f the peripheries of the wheels, C, D. These are at their lower parts serrated with ratchet as shown. Another bar, M, of like kind, resting s jointed to an arm of a lever, N, the other arm



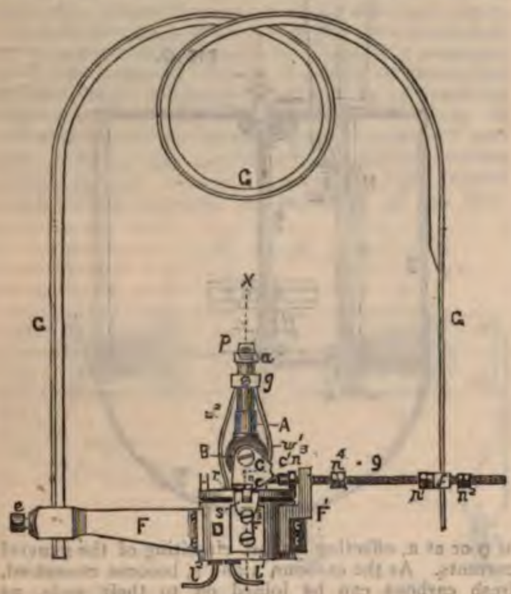
ich projects as a tappet under the core, H. the points of the carbons is fixed a reflector, O, may be of marble or other refractory material ed in a band, o. The operation of the lamp is ows:—As the distance between the points of the ıs, A and B, increases by their consumption, the nce to the direct circuit of the lamp increases, ınsequently a larger amount of electricity passes h the by-pass circuit of the solenoid coil, E. ore, H, is thus attracted upwards, and by its it draws up the two bars, K and L. These, as etire from their rests at k and l, come to bear heir ratchet teeth against the wheels, C and D, they still ascend they cause these wheels to turn round in the direction of the arrows, thus turnıe grooved rollers, a and b, and causing the ıs to approach one another. Should the carbons near, so that the resistance in the direct circuit lamp is small, then the solenoid, E, having little , the core, H, descends, and when it has descended some distance it moves the tappet lever, N, raising the bar, M, which, acting on the wheel, D, causes it to turn partly round in a direction opposite to the arrow, and so to retract the carbon, B. The other carbon, A, is given an advancing movement, somewhat greater than that of B (which is effected by making the wheel, C, a little smaller in diameter than D, or by making the roller, a, a little larger in diameter than b), and is provided with a stop stud, P, which permits it to advance only as that portion of the carbon near its point against which the stop bears becomes consumed. Contacts, Q, R, are provided for the ends of the levers on which the rollers, a^1 and b^1, are mounted, these contacts being connected by wires, q, r, to the two insulated frames of the lamp. Thus, when either carbon is absent, the roller, a^1 or b^1 drops, and contact is made



at Q or at R, effecting a short circuiting of the general currents. As the carbons, A and B, become consumed, fresh carbons can be joined on to their ends, as indicated at fig. 3.

4626. "Apparatus for lighting and extinguishing gas by electricity." W. R. LAKE. (A communication from abroad by George D. Bancroft, of Boston, America.) Dated November 10. 6d. The figure is a front view of a burner and the apparatus which is attached to each burner in the circuit. A is a gas-burner, having the tip, a. B is the cock to which is screwed a sector or segmental arm, C, by which the said cock is turned. D is a cylindrical or round box, formed of iron, and having a hollow core, around which is wound a coil of wire, the box, coil, and core forming an electro-magnet. The core is screw-threaded at its upper end to receive the gas-burner, and at the lower end to screw upon the gas pipe is an armature hinged to a metal block which is screwed to the box, D. A spring, s, working in a pair of U shaped arms of a similar block, F^2, presses against a projection upon the armature, also lying between the said arms, and raises the armature, when the electro-magnet is demagnetised. G is a spring exposed to the heat of the gas-flame as shown, and secured at one end by a set screw, e, to a bracket, F, upon the

box, D, while its other end passes through a slot in the metal block, *f*, upon a rod, *g*, in which block it is kept from slipping by a tightening screw. This block, *f*, slides freely upon the rod, *g*, but its range of motion is limited by two nuts, n^1, n^2. The inner end of the rod, *g*, is attached to a crank-pin on the segmental arm, C, and the rod has a longitudinal motion in a slot, *t*, in the bracket, F^1, which motion is limited by nuts n^3, n^4, as shown. The segmental arm, C, has two shoulders, *c*, c^1, and the armature, H, has a projection, *r*, as shown. Behind the burner are two stiff, heavy wires, w^1, w^2, as shown, the former connected with one end of the coil of the electro-magnet, and the latter with the line wire, l^2. These wires, w^1 and w^2, are properly insulated, and pass through suitable bushings in the armature, H, and the wire, w^2, passes through the box, D. Above the said armature they pass through a block, *g*, secured to the burner, and end in two small binding screws, m^1, m^2, which are connected by a platinum wire, *p*, near the tip, *a*. The line wire, l^1, is connected with the coil of the electro-magnet. It is also connected with a suitable battery, and a make-and-



break circuit key at the operating station. The spring, G, is formed of two kinds of metal, brass and steel, the steel being the long thin strip shown, and the brass the stouter short strip. In its normal condition this spring exerts its force inward towards the burner, but when subjected to heat the expansion of the metal causes it to press outwards away from the burner. In the normal condition of the apparatus the shoulder, *c*, of the segmental arm, C, is caught upon the projection, *r*, of the armature, H. The operation of the apparatus is as follows:—To light the gas the operator sends a current over the line wire, l^1. The electro-magnet, overcoming the force of the spring, pulls down the armature and releases the shoulder, *c*, from the projection, *r*; the spring, G, being at the temperature of the atmosphere, forces inward the segmental arm, C, thereby opening the cock. At the same time, the current passing through the platinum wire, *p*, so heats the same that it ignites the escaping gas; when the operator then breaks his circuit at his distant station the projection, *r*, flies up against the shoulder, c^1. After the gas has continued to burn a few minutes, the thermo-spring, G, will become so heated by the gas flame as to exert its force in the opposite direction, and a single impulse of the electric current then sent over the line will release the shoulder, c^1, and close the cock.

4628. "Step-by-step type printing telegraphs." F. H. W. HIGGINS. Dated November 10. 6d. Has for its object improvements in step-by-step type printing telegraphs. The improvements relate to an arrangement of the mechanism of type printing instruments, which causes the printing to be done on a broad sheet of paper in lines like a newspaper, instead of as formerly in a single line on a continuous narrow band.

4674. "Telegraph cables." ROBINSON KENDAL. Dated November 13. 2d. Has for its object improvements in telegraph cables. A ribbon of sheet zinc is wound helically around the cable to be protected, so as entirely to inclose it, as it were, in an open jointed tube. One ribbon of sheet zinc having been thus wound on, a second similar ribbon is wound in the reverse direction, so that in the result the cable is double sheathed, and the twists being in opposite direction there is no tendency to unwind. (*Provisional only.*)

4739. "Electric batteries." H. E. NEWTON. (A communication from abroad by Lucien Alfred Wilhelmine Desruelles, of Paris.) Dated November 17. 4d. The carbon and zinc plates are inclosed in some fibrous or spongy substance, such as asbestos or spun glass, which will not be affected by the acids used for exciting the battery, but which will, by reason of capillary attraction or by molecular adherence, hold the exciting liquid in suspension. To facilitate the application of the invention to all kinds of batteries the saturated fibrous substance may be made up into small cakes, which are then compressed to get rid of any excess of acid; the cakes are then covered with a thin coating of dextrine, which in drying gives them great solidity. When it is desired to use such a cake it is only necessary to moisten it with pure water, and place it in the battery.

4745. "Electric lamps." J. E. H. GORDON. Dated November 17. 2d. Has for its object improvements in electric lamps. In electric lamps in which a precious metal, and especially the metal iridium, is employed, and being intensely heated becomes a source of light, an appreciable loss of metal is after a time experienced from the parts exposed to the high temperature. The object of the invention is to recover the metal which is so dissipated. This is done by causing a current of air to pass through the lamp, and afterwards through a flue or channel in which a large surface of an inert material is exposed. (*Provisional only.*)

4779. "Electro-magnetic apparatus for table services, offices, and warehouses." FLORENTIN HARMANT. Dated Nov. 19. 4d. This invention refers to a line of rails and carriages actuated solely by electricity or in conjunction with mechanical aid, such, for example, as a chain, metal rope, rack, or screw, but where electricity plays the principal part.

4825. "Dynamo-electric motors." CARL KESSELER. (A communication from Ernst Kuhlo, of Stettin.) Dated November 22. 4d. The object of this invention is to continuously cause the attraction of an electro-magnet to act upon a conductor or transmitter of power without interrupting the current, and thereby preventing a cessation of the power for a single moment. (*Provisional only.*)

4862. "Telephones." SYDNEY PITT. (A communication from abroad by Charles de Nottbeck, of St. Petersburg.) Dated Nov. 23. 2d. Has for its object

improvements in telephones. The mouth-piece of the transmitting telephone is closed by pasting or cementing over it a diaphragm of paper or like material. Also the bobbin is attached to the vibrating plate of the receiving telephone in place of to the magnet, as is usual. (*Provisional only*).

4886. "Dynamo-electric machines." JOHN HOPKINSON and ALEXANDER MUIRHEAD. Dated Nov. 24. 8d. Has for its object improvements in dynamo-electric machines and lamps for electric lighting. Figures 1 and 2 show a convenient method by which, according to the invention, the sparks which occur between the commutator and the collecting brushes in continuous current machines are reduced; *a*, *a*, *a*, are the segments of the commutators insulated from each other; b^1, *b*, *b*, are the collecting brushes or their equivalents carried on a spindle, *c*; one of these brushes, b^1, is ar-

FIG.4.

FIG 3

FIG.2

FIG I

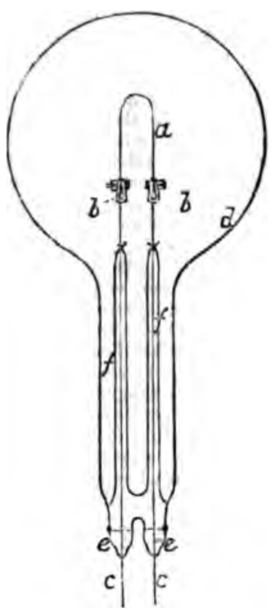
ranged in such wise that there is an electrical resistance between the brush, b^1, and the spindle, *c*. *d*, *e* are metal cylinders; to *d* the brush is attached, whilst *e* is in contact with the spindle, *c*. The space, *f*, between *d* and *e* is filled with a mixture of plumbago and lamp black, having a suitable resistance; the ends of the space, *f*, are closed with discs of ivory. The brush, b^1, is so adjusted by bending or otherwise that it remains in contact with any segment of the commutator for a short space after the other brushes have left contact with that segment. The effect is, that instead of sudden rupture of continuity of the armature circuit connected to the segment of the commutator, a resistance is first introduced, and contact is not broken till the current has been in some measure reduced. For the more convenient adjustment of the machine several sets of brushes are provided having different resistances; it is ascertained by trial and use which gives the best result. Figs. 3 and 4 show the armature used in machines arranged so that the coils lie in planes parallel or nearly parallel with the plane of revolution of the armature. *a* is a pulley to be keyed on the shaft of the machine; it is surrounded by a series of layers, *b*, of sheet iron, more or less insulated from each other. In one or both faces of this ring of layers of iron radial slots are cut for the reception of the coils of insulated wire, *c*. On the pulley is coiled a band of sheet iron and of asbestos paper, so that the asbestos paper separates the successive layers of iron from each other. When a sufficient thickness has been obtained radial holes are drilled, and bolts, *d*, are inserted and secured by the cottars, *e*; the slots are then cut. The figures show the armature as arranged for a continuous current, that is, with the slots on one side halfway between the slots on the other side of the armature. This is done in order that the current may be more approximately continuous; but when an alternating current is desired, the slots in the opposite faces correspond.

4914. "Electric light apparatus." W. L. WISE. (A communication from abroad by Jacques Ambroise Mandon, of Paris.) Dated Nov. 25. 8d. Has for its object improvements in electro-light apparatus, and relates particularly to a novel method whereby two pencils or carbons are kept with their upper extremities or poles in proper relative positions, notwithstanding the consumption, wasting, or wear due to the action of the electric current producing the light. To this end in one arrangement, wherein each carbon is formed as an arc of a circle, each carbon or pencil is carried or supported and balanced by apparatus arranged so that in proportion as the carbon or pencil is consumed or reduced by the action of the electric current, the carbon or pencil will automatically move upward in a circular path about a centre, coincident with that of the circle whereof the carbon or pencil represents an arc.

4933. "Electric lamps." J. W. SWAN. Dated Nov. 27. 6d. Relates to incandescent lamps. The carbon conductor is formed from cotton thread which has been subjected to the action of sulphuric acid of such a strength as to cause a change or conversion to take place in the thread of a similar character to that which is produced by the treatment of bibulous paper with sulphuric acid, according to the well-known process of making vegetable parchment. The cotton thread after being immersed in this solution and allowed to remain therein for a sufficient time to effect the required conversion, is removed from the solution and washed with water until the whole of the acid is eliminated, after which it is dried and carbonised by any of the suitable well-known means. The description of cotton thread most suitable for treatment in the manner described is that known as crotchet thread. The figure shows how the carbon filament is secured to the holders. *a* is the carbon formed of the prepared cotton thread, which is bent round and gripped at its two extremities by clips, *b*, to which the upper ends of the metal conductors, *c*, are attached; the carbons thus arranged, together with a convenient length of the metal conductors, *c*, are surrounded by a glass bulb or receptacle, *d*, and the lower ends of the metal conductors which pass through the bottom of the glass receptacle, *d*, are sealed into the same, but when metal

conductors of large sectional area are employed, it is preferred to secure their lower ends to platinum caps,

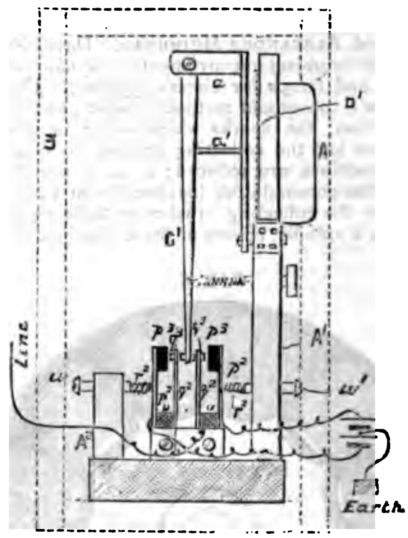
FIG. I.



e, which are attached to the bottom of the glass receptacle, *d*, by fusing the glass around the caps.

4961. "Mechanical contrivances for electro-magnetic clocks," &c. JOHANN MAYR. Dated Nov. 29. 2d. Consists in mechanical improvements, by means of which it is possible to construct a new system of electric clocks and improved signalling apparatus, and to replace the usual sliding spring and mercury contact by reliable metallic contacts with impact motion and exactly controllable duration. (*Provisional only.*)

4981. "Telephonic apparatus. W. R. LAKE. (A communication from abroad by Charles Adams Randall, of New York.) Dated Nov. 30. 1s. This invention consists mainly of a telephone system, in which, by means of a variable contact pole changing circuit-closer, operated by a diaphragm under the influence of sound vibrations, electrical connection with a line wire is alternately made and broken from opposite poles of a battery or batteries, the makes and breaks of the circuit being attended by varying pressure between the contact points of the circuit-closer, and battery currents or impulses of alternately opposite polarities and varying force are caused to pass over the line circuit in correspondence to sound vibrations. In the fig. A is a mouth-piece, containing a diaphragm, supported by a standard, A^1, and from the upper portion of the said mouth-piece case projects an arm, *a*, to which is pivoted the upper end of a lever, G^1, from which projects an arm, a^1, in contact with the diaphragm at D^1. The lower end of this lever is preferably provided with insulating studs (if the lever is metal). In each of the line and battery contact devices a rock shaft, *u*, journalled in suitable bearings, has fixed thereto a block, *v*, of hard india-rubber or other insulating material, and from this block project upward the plates, p^2, and springs, q^2, which respectively carry the carbon buttons, p^3, and platinum studs, q^3. Springs r^2, r^2, press against the plates, p^2, and have their tension controlled by screws, w^1, w, passing through the standards, A^1 and A^2. The connections between the line wire and the battery are made in the manner shown. By means of the screws, w, w^1, it is obvious that the amount of pressure between the platinum studs, q^3, and carbon



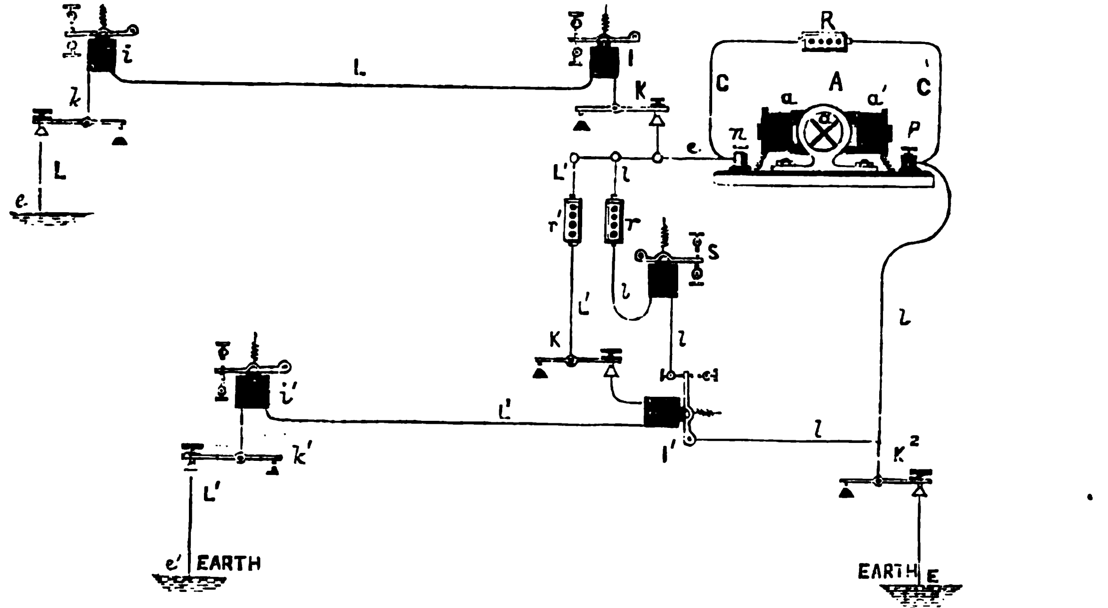
buttons, p^3, under the action of the lever, G^1, may be regulated, as the plates, p^2, and their rock shafts are alternately oscillated by the movement of the lever, G^1, and the carbon buttons, p^3, are brought into varying degrees of contact pressure with the platinum studs, q^3, on the springs, q^2.

5033. "Electric lamps." J. H. JOHNSON. (A communication from abroad by Auguste de Meritens, of Paris.) Dated Dec. 3. 2d. Relates to improvements in the production of light by electricity, and it consists in the employment of iron rendered incandescent by the passage of an electric current of high tension. (*Provisional only.*)

5068. "Telephonic and electric communication," &c. J. N. CULBERTSON and J. W. BROWN. Dated Dec. 6. 6d. Has for its object improvements relating to telephonic intercommunication, so as to get rid of telephonic induction. With this object the switch board at the central office is so arranged that each wire has an independent earth plate.

5352. "Dynamo-electric telegraphy." SYDNEY PITT. (A communication from abroad by Orazio Lugo, M.D., of New York.) Dated Dec. 21. 8d. Relates to the application of dynamo-electricity for the transmission of telegraphic signals. The arrangement of the apparatus is shown by the figure. A represents the dynamo-electric generator, having its armature coils, *a*, and field magnets, a^1, a^1, connected together in the same circuit. The exterior or working circuit consists of the wire, *l*, which connects the positive pole, *p*, of the generator, A, with the earth at E (and which together with the earth itself forms a conductor of no appreciable resistance), the wire, 6, also of no appreciable resistance, and three telegraphic circuits, L, L^1, and *l*, which branch from the wire, 6, at the negative pole of said generator, and terminate the first two in the earth at *e* and e^1 respectively, and the third in the wire, *l*, at the positive pole. The telegraph lines, L and L^1, are each provided with transmitting keys, K, *k*, K^1,

k^2, for alternately breaking and closing the circuit in order to transmit intelligible signals, and also with suitable receiving instruments, I, i, and I^1, i^1, these being placed at different stations, as shown. The line, connects the positive and negative poles, p and n, of the generator, A, and it, in effect, forms a branch of the exterior circuit. In order to maintain the proper relation between the resistances of different portions



l, l, represents a local circuit of small resistance, which is employed to actuate a sounder or other like instrument, S, through the intervention of the instrument, I^1, which is shown as a relay. The shunt circuit, C, C, of the systems, the resistance of the shunt circuit is made adjustable. Resistances, r, r^1, are inserted in the shorter lines, so as to bring each of the resistances of the latter to a level.

City Notes.

Old Broad Street, July 13th, 1881.

THE EASTERN TELEGRAPH COMPANY, LIMITED.—The report of the directors for the six months ended 31st March, 1881, states that the Company's revenue for this period amounted to £302,158 18s. 3d., from which is deducted £67,754 0s. 7d. for the ordinary expenses of the Company, and £29,942 1s. 2d. expenditure on repairs of cables during the half-year, and £3,276 5s. 6d. for income tax, leaving £201,186 11s. 0d., which, together with £28,430 8s. 1d. brought forward from the preceding half-year, gives a balance of £229,616 19s. 1d. From this balance £22,629 15s. 0d. has been paid for interest on debentures, and £20,473 17s. 6d. for dividend to 31st March, 1881, on the preference shares, and £70,000 has been placed to the General Reserve Fund. This sum, with £18,771 13s. 9d. received during the half-year for interest and profit on sale of investments, brings up that fund to £356,608 13s. 6d., and with the special reserves mentioned in the balance-sheet makes the total amount of the reserves £392,060 12s. 3d. The directors have, during the half-year, paid an interim quarterly dividend of 1¼ per cent. on the ordinary shares. They now recommend the declaration of a final dividend for the year ended 31st March, 1881, of 2s. 6d. per share and a bonus of 1s. per share, both payable on the 15th inst., making, with the three previous payments on account, a total dividend for the year of 5¼ per cent. on the ordinary shares, and that the balance £2,723 6s. 7d., be carried forward to the next account All the Company's cables are in good working order with the exception of one of the cables between Aden and Bombay, which was recently interrupted in shallow water close to the Bombay shore, and will be speedily restored. Reference was made in the last report to the direct Lisbon cable broken off the coast of Portugal, in 2,000 fathoms of water. The restoration of the line was completed by the s.s. *Chiltern* in May last. The s.s. *Chiltern* has also been engaged in laying a cable from Sicily to the Island of Lipari, a distance of 23 miles, and a new 3-conductor cable across the Straits of Messina. These lines have been laid under agreements with the Italian Government, in consideration of the payment by the Government of subsidies amounting to £1,050 per annum for 30 years. The cost will be charged to revenue account. The revenue includes £19,500 dividend and bonus for the half year upon the Company's shares in the Eastern and South African Telegraph Company, the dividend being at the rate of 6 per cent. per annum, with a bonus at the rate of 4 per cent. per annum. £30,000 has been placed to reserve, and £2,114 1s. 1d. carried forward. The Eastern and South African Company have paid over £16,683 6s. 8d. to the trustees of the Sinking Fund for redemption of the debentures. The total amount of the Company's reserves is now £59,014 15s. 5d. The revenue account also includes £2,600 dividend for the half-year on the shares of the Black Sea Telegraph Company belonging to this Company, by whom the line is worked and maintained under agreement.

ANGLO-AMERICAN TELEGRAPH COMPANY, LIMITED.—Mr. H. Weaver, the managing director of this Company, informs us "that the Brest-St. Pierre cable laid in 1869, which was broken on the 12th November last, has been picked up in 1,700 fathoms of water and repaired by the Telegraph Construction and Maintenance Company with their s.s. *Scotia*, under the superintendence of Mr. F. R. Lucas, engineer to that Company, and Mr. H. C. Forde, acting as engineer upon behalf of this Company. As a consequence of the repair just effected, telegraphic communication between France and the United States of America by this Company's cable *via* Brest has been restored. The Company has now four Atlantic cables at work, *via* Valentia and *via* Brest, and their system throughout is in good working order and condition."

THE DIRECT UNITED STATES CABLE COMPANY, LIMITED.—We are informed under date the 8th of July that at a meeting of the board held on that day it has been resolved to recommend a final dividend of five shillings (5s.) per share (free of income tax), such dividend to be payable on and after the 16th August next, making with the interim dividends already paid five per cent. for the year ending 30th June last, carrying forward £7,179 10s. 8d., after having carried to the reserve fund £32,292 9s., making it up to £235,000.

THE AMERICAN TELEGRAPH AND CABLE COMPANY.—The final splice in this Company's cable was made at 10.20 p.m. on the 8th instant. The cable is in every respect said to be a first-class one.

THE CUBA SUBMARINE TELEGRAPH COMPANY, LIMITED.—The balance-sheet and accounts for the half-year ended 30th June last state that the gross receipts, including the balance brought from last account, amount to £18,503 9s. 1d., and the gross expenditure to £5,714 6s. 2d., leaving a sum of £12,789 2s. 11d. to the credit of revenue account. Of this, the sum of £3,750 11s. 9d. has been placed to the reserve fund, increasing that fund to £40,000. After providing for the preference dividend, a balance of £6,038 11s. 2d. remains, out of which the directors recommend the payment of a dividend on the ordinary shares at the rate of 7 per cent. per annum, the same rate as was paid for the corresponding period of last year, free of income tax, which will absorb £5,600, and leave £438 11s. 2d. to be carried forward to the current half-year's account. The directors have much pleasure in reporting that the new cable contracted for with Messrs. Hooper's Company to replace the original one was laid from Cienfuegos to Santiago de Cuba by the s.s. *Hooper* in February last in perfect working order and excellent electrical condition, and has continued to work most satisfactorily. The shareholders will also be pleased to learn that the Company's other cables continue in good working order. The suit instituted against the Spanish Government at Havana for a return of the tax (about £1,000) erroneously levied on the Havana-Santiago business has been decided by the Court there in favour of the Company, but the decision having been appealed against to Madrid, it will be several months before a final settlement of the case can be looked for.

The following are the final quotations of stocks and shares for the 13th inst.:—Anglo-American, Limited, 53¼-53¾; Ditto, Preferred, 85-86; Ditto, Deferred, 25-26; Black Sea, Limited, ——; Brazilian Submarine, Limited, 10¼-10¾; Brush Light, 3½ pm.; Electric Light, ¼-½ pm.; Consolidated Telephone Construction, 1/16-3/16 pm.; Cuba, Limited, 9¼-9¾; Cuba, Limited, 10 per cent. Preference, 16¾-17¼; Direct Spanish, Limited, 4⅝-5; Direct Spanish, 10 per cent. Preference, 13½-14½; Direct United States Cable, Limited, 1877, 10⅞-11⅛; Debentures, 1884, 102-104; Eastern Limited, 10½-10¾; Eastern 6 per cent. Preference, 12⅞-13⅛; Eastern, 6 per cent. Debentures, repayable October, 1883, 103-106; Eastern 5 per cent. Debentures, repayable August, 1887, 104-107; Eastern, 5 per cent., repayable Aug., 1899, 106-109; Eastern Extension, Australasian and China, Limited, 11⅝-11⅞; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 109-112; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 103-106; Ditto, registered, repayable 1900, 103-106; Ditto, 5 per cent. Debenture, 1890, 103-105; Eastern and South African, Limited, 5 per cent. Mortgage Debentures, redeemable 1900, 103-106; Ditto, ditto, to bearer, 103-106; German Union Telegraph and Trust, 11-11½; Globe Telegraph and Trust, Limited, 6⅜-6⅝; Globe, 6 per cent. Preference, 12½-12¾; Great Northern, 13¼-13¾; 5 per cent. Debentures, 102-105; India Rubber Company, 20½-21½; Ditto, 6 per cent. Debenture, 104-108; Indo-European, Limited, 28-29; London Platino-Brazilian, Limited, 5⅞-6⅛; Mediterranean Extension, Limited, 2½-3; Mediterranean Extension, 8 per cent. Preference, 8¾-9¼; Oriental Telephone, ⅜-⅝; Reuter's Limited, 12-13; Submarine, 285-295; Submarine Scrip, 2¾-3; Submarine Cables Trust, 100-104; United Telephone, 9¼-9½; West Coast of America, Limited, 4½-5; West India and Panama, Limited, 1⅞-2⅛; Ditto, 6 per cent. First Preference, 7-7½; Ditto, ditto, Second Preference, 6½-7; Western and Brazilian, Limited, 8⅜-8⅝; Ditto, 6 per cent. Debentures "A," 110-115; Ditto, ditto, ditto, "B," 98-102; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 101-105; Ditto, 6 per cent. Sterling Bonds, 106-110; Telegraph Construction and Maintenance, Limited, 32¼-32¾; Ditto, 6 per cent. Bonds, 103-107; Ditto, Second Bonus Trust Certificates, 3⅞-4⅛.

TRAFFIC RECEIPTS.

NAME OF COMPANY.		MAY.	JUNE.	REMARKS.
		£	£	
Anglo-American...	1881	49,880	48,240	
	1880	*41,970*	*19,580*	
Brazilian S'marine	1881	13,607	12,272	
	1880	*10,331*	*10,524*	
Cie. Française ...	1881	...	...	Not published.
	1880	..	..	
Cuba Submarine...	1881	3,000	2,757	
	1880	*2,972*	*3,147*	
Direct Spanish ...	1881	1,547	1,456	
	1880	*1,334*	*1,877*	
Direct U. States ...	1881	13,990	16,080	At 2s. per word
	1880	*16,630*	*6,580*	" 1s. 6d. "
Eastern	1881	43,872	40,074	
	1880	*42,963*	*42,522*	
Eastern Extension	1881	29,523	29,339	
	1880	*26,570*	*20,100*	
Great Northern ...	1881	21,600	21,760	
	1880	*19,480*	*20,520*	
Indo-European ...	1881	...	...	Not published.
	1880	..	..	
Submarine	1881	...	...	Publication temporarily suspended.
	1880	..	..	
W. Coast America	1881	...	...	
	1880	..	..	
West. & Brazilian	1881	9,249	3,943	
	1880	*7,797*	*3,726*	
West India	1881	5,560	4,743	
	1880	*3,775*	*3,997*	

E TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. IX.—No. 204.

HE PARIS ELECTRICAL EXHIBITION.

doubt whether there is a single instance on rd of an Industrial Exhibition being ready for ing on the appointed day. The Paris Elec- l Exhibition forms no exception to this riable state of things, and the ceremony which aid to be arranged to take place on the 1st of ust, if it does take place, which seems doubtful, be a mere farce, as it is certain that the ngements in the various sections will be very from complete at the beginning of the month. eems somewhat strange that the delay which always hitherto taken place on such occasions not acted as a cure, but it seems that, for some on or other, such cannot be the case.

he Palais de l'Industrie, in which the exhibition be held, is certainly admirably adapted for the pose, as the amount of space available for the ous exhibits is ample. As far as can be seen at ent, the display which will be eventually ented will be very imposing, and will go far to one an idea of the vast strides which electrical nce has made within the last few years, and of important position in the arts which it occupies. lthough nominally electrical, the exhibits in ny cases will not be directly identified with tricity; a very large number of makers, for ance, will show fine specimens of stationary ines which, although nominally employed for ing dynamo-electric machines, are not neces- ily, or indeed as a rule, to be employed for that pose. At the time we write there are many ns of heavy engineering work being done, but machines which are to be driven have either not ived, or are still securely packed in the numerous es which strew the exhibition building in parently) hopeless confusion.

n the centre of the great nave a model light- se is in course of erection, from the lantern of ich the brilliant rays of the electric light will be d. This erection will be the most conspicuous ect in the building, and rightly so, as it was to thouses that the electric light was first applied h the greatest success. Many of our readers l no doubt recollect the interest which was taken in the highly successful show of the Holmes light in the British Exhibition of 1862, the latter being a date at which dynamo machines were unheard of, though it is now a source of wonder that they were so.

Numerous stands of more or less picturesqueness are scattered about the great nave in various stages of advancement, and conspicuous amongst these will be that erected for the British Postal Telegraph Administration, and in which a highly interesting display of ancient and modern apparatus (much being in working order) will be made. The great nave, as a rule, is restricted to purely telegraphic and electrical instruments, the heavier machinery being placed beneath the galleries. The display of apparatus in connection with electrical railway sig- nalling promises to be extensive; in this depart- ment there has been an undoubted advance within the last few years, though it has been a difficult subject to deal with; considering the requirements that are necessary to make it really successful, it is by no means a subject which amateurs can deal with with chance of success.

NEW COMPANIES.—A list of companies registered between January 1st, 1881, and June 30th, 1881, has recently been published in the *Investor's Guardian*. From it we have abstracted the following, which shows the names of those companies which are more or less connected with electricity, together with the amount of capital authorised in each case:

	CAPITAL.
Automatic Telegraph Company, Limited	£100,000
Anglo-Continental Telephone Company, Limited	50,000
British Gower Bell Telephone Company, Limited	600,000
Consolidated Telephone Construction and Maintenance Company, Limited	300,000
Electric Gas Lighting Company, Limited	20,000
Electric Light and Power Company, Limited	150,000
Fitzgerald Electric Light Company, Limited	100,000
Lancashire and Cheshire Telephone Company, Limited	250,000
Oriental Telephone Company, Limited	300,000
Provincial Telephone Company, Limited	75,000
Siemens Brothers and Company, Limited	400,000
Swan's Electric Light Company, Limited	100,000
Telephone Manufacturing and Maintenance Company, Limited	250,000
Telegraph Improvement Company, Limited	100,000
Representing a total capital of	£2,795,000

WE hear that the power absorbed by the Maxim machine in driving 120 Maxim together with 10 Weston lamps at the recent display in Euston Road, was ——, well, something enormous. Was it 70 horse-power?

HENLEY'S NEW DYNAMO-ELECTRIC MACHINES.

Mr. W. T. Henley, the well known telegraph engineer, has recently patented the following forms of dynamo-electric machines, which have, we believe, proved on trial to be quite successful.

Fig. 1 is a longitudinal sectional view of one of the improved forms of dynamo machines; fig. 2 is a transverse section showing the arrangement of the electro-magnets and revolving wheel carrying

FIG. 1.

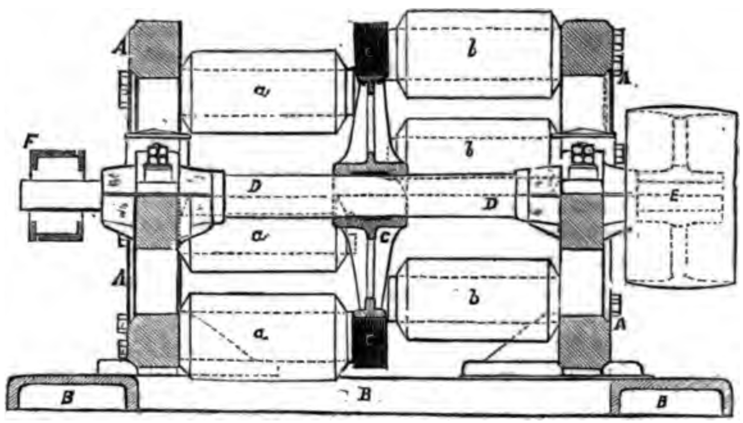


FIG. 2.

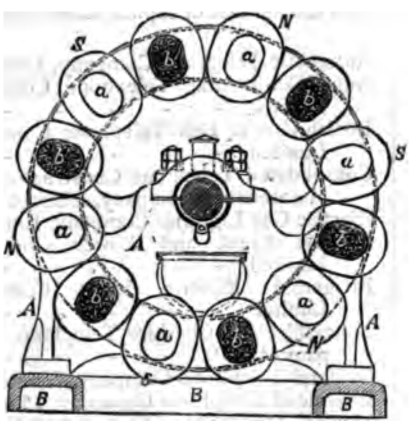
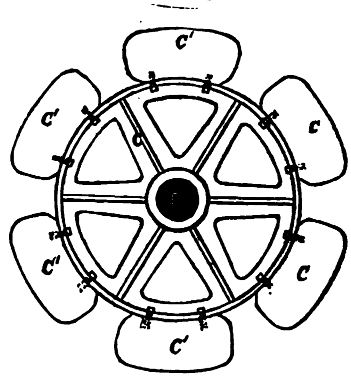


FIG. 3.



pieces of iron; fig. 3 shows the revolving wheel with the pieces of soft iron attached. A, A, are cast iron standards fixed to base plate, B, and to which the electro-magnets, *a, a, a, a, a, a*, and *b, b, b, b, b, b*, are bolted; these are made of cast or wrought iron, or, better, pieces of soft iron tube, which may be of the oval section shown in fig. 2, having soft iron ends welded in next the standards for bolting to the same; these tubes are filled with soft iron wire lengthways of the tube forced in tight, and are so fixed that their poles do not stand opposite each other, but the poles of the electro-magnets on each

standard stand midway between the poles magnets on the other standard. C is the whe of brass fixed on the shaft, D; C^1, C^1, C^1, C^1, are six pieces of soft iron; these are fixe wheel, C, and as they revolve with the whe bring the poles of the electro-magnets c standard alternately in magnetic connectio the poles of the electro-magnets on the standard. The currents produced are by a c tator made to flow all in one direction throu coils of the magnets on one standard, so th poles of those magnets always remain c

character, every alternate pole being nort other south, so that in one revolution of the with the pieces of iron these pieces are broug close proximity with the poles of the e magnets marked *a* and *b*. As the wheel, C, r the electro-magnets, *a, a*, having their remaining of the same character, the pieces C^1, C^1, alternately make magnetic con between the poles of the electro-magnet and *b, b*, causing the latter to have their reversed 12 times in each revolution of the w For instance, supposing the wheel, C, fig. 3, to b

l to its place in fig. 2 in its present position, the upper piece of iron, C^1, would be opposed to orth pole of the electro-magnet on the right making that end of the piece of iron a south the other end a north. This would render ole of the electro-magnet, *b*, on the left a south but when the wheel had advanced one-twelfth evolution to the right, the upper piece of iron ft the pole, *b*, and the following piece of iron laced it in connection with the south pole of other electro-magnet, *a*, thus reversing its ity, making it a north; and, as before stated, magnets, *b*, *b*, to terminals at the other end of the machine, and the current for producing the light or other effect can be brought from either end of the machine.. From one end alternate currents would be obtained, and from the other end currents all in one direction would be obtained, the terminals at the end from which the current is not taken being connected by stout copper wire.

Fig. 4 is a longitudinal section of another arrangement; fig. 5 is a transverse section; fig. 6 shows a wheel made of brass or other non-magnetic material carrying in this case pieces of iron, shown

FIG. 4.

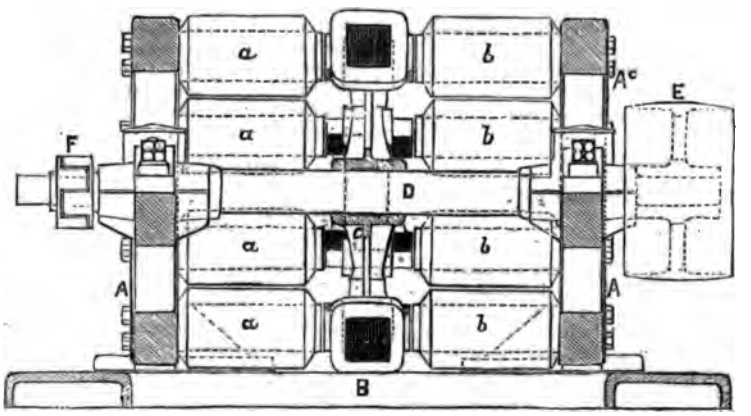


FIG. 5.

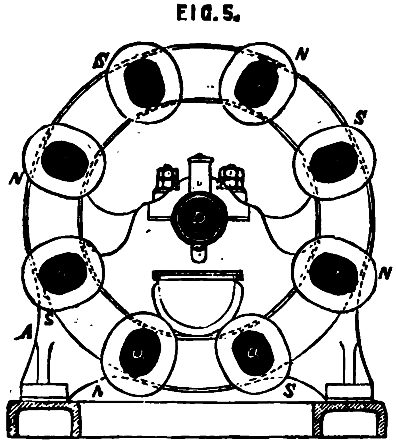
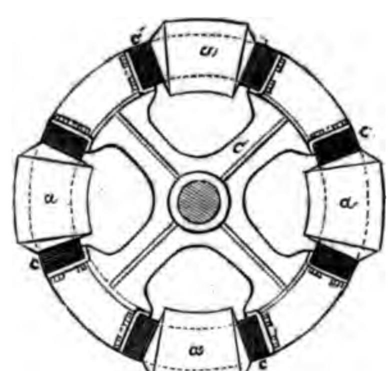


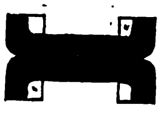
FIG. 6.



reversal takes place 12 times in each electronet on one standard during one revolution of wheel, C, but the pieces, C^1, C^1, C^1, have their rity reversed only six times during the same time. coils of the electro-magnets are connected with commutator by means of the usual springs or hes of metal pressing on the pieces of metal ting the commutator. In conveying the ents from the electro-magnets to the commu-, and from the same, the wires from the electronets, *a*, *a*, are attached to terminals at one end he machine, and the wires from the electro- separately at fig. 7, which are made of sheet iron bent in the shape shown in this plan, fig. 7; these pieces of soft iron are wound with coils of wire so as to become electro-magnets. A, A, are the standards; B, the base plate; C, the wheel; *a*, *a*, *a*, *a*, *a*, *a*, and *b*, *b*, *b*, *b*, *b*, *b*, the electro-magnets; D, the shaft; F, the commutator; and E, the driving pulley. The iron pieces, *c*, *c*, *c*, *c*, on the wheel, C, are wound with coils of covered wire. The electro-magnets, *a*, *a*, *a*, and *b*, *b*, *b*, are placed with the poles of the electro-magnets on each standard opposite each other, as in figs. 5, 6 and 7. The com-

mutator is so arranged that the fixed electro-magnets have similar poles opposite each other continually, as shown in fig. 5, so that the revolving electro-magnets have their polarity reversed eight

FIG. 7.



times in each revolution; if required, the currents may alternate in the fixed magnets, and then be brought by means of the commutator to the revolving magnets in such a way as to make their polarity remain of the same character continually.

ON THE REFRACTION OF ELECTRICITY.

By ALFRED TRIBE, Lecturer on Chemistry in Dulwich College.

IN a paper read at a meeting of the French Association, Algiers, April 18th, 1881, Mr. Tribe described an ingenious chemical method which he had devised for investigating the field of electrolytic action. As the results of the author's experiments, described in the communication to the Royal Society, are based upon this method, a description of the latter, given in the paper referred to, will render more clear the account of the remarkable experiments on the "refraction of electricity."

When a rectangular plate of metal unconnected with the battery is placed lengthwise in an electrolyte undergoing electrolysis, the plate does work identical in kind with that being done by both electrodes. The electro-positive ion of the electrolyte separates and distributes itself on a portion of the plate nearer the + electrode, and the electro-negative ion on another part of the plate nearer the — electrode. The respective boundaries of these ions are sharply defined, and the intermedial space free from either ion.

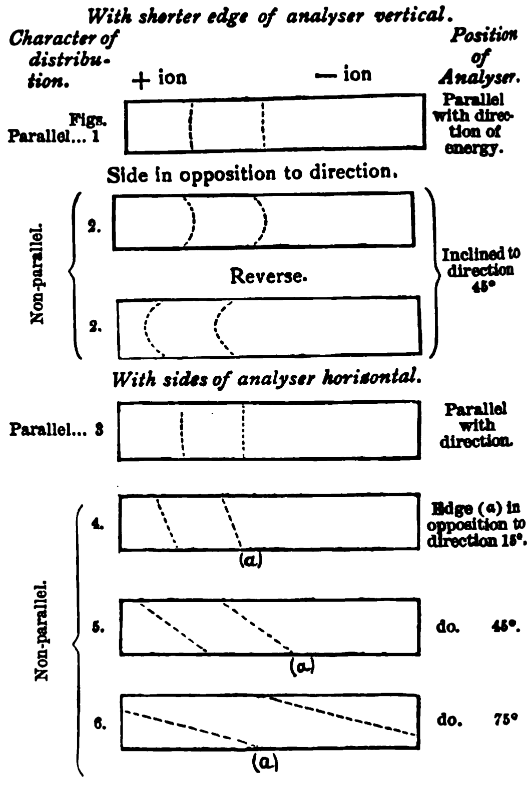
When an aqueous solution of copper sulphate is electrolysed with silver electrodes, copper, of course, separates on the — electrode; but more or less of the dark-gray or black silver peroxide forms on the + electrode. $\frac{1}{10}$ of a weber in one minute produces, in fact, a sensible separation of copper and a sensible formation of silver peroxide on a silver plate 34 millim. x 7 millim.

It follows, therefore, that a silver plate placed in a solution of copper sulphate, under the conditions named in the first paragraph, should have copper deposited on that part which may be supposed to receive — electrification, and silver peroxide on that which receives the positive. Such is the case.

The registration of any set of electrifications in this way by the ions of electrolytes need take only a few minutes, the minimum time being determined by the dimensions of the analyser,* strength of electrolyte, and available current.

After the electric energy has done enough work on the analyser for the action to be visible, time is seen to exert no influence in determining the magnitudes of the distributions. Thus in 6 minutes and 60 minutes respectively, identical distributions were recorded by similar analysers, other circumstances being the same. But the magnitudes of the distributions registered by an analyser of given dimensions vary with every condition which may be supposed to alter the chemical or physical state of the electrolytic medium, as temperature, proportion of water, and electric quantity.

When at ordinary temperatures the analyser is placed with its length perpendicular to the electrodes in a homogeneous field,* although the superficial magnitudes of the ions vary, as stated, with any variation in the condition of the electrolytic medium, yet in every case one quality is seen to obtain, namely a similarity of the same ion on the two sides of the analyser, both as regards magnitude and configuration of its boundary line. This happens whether the plate has its shorter edge vertical or is supported with its sides horizontal. Under these circumstances the boundaries of the ions are practically parallel with the shorter edge. Distributions having all these characteristics are named *parallel* (figs. 1 and 3).



When the course of the energy makes an oblique angle with the edges of the analyser, but remains parallel to the sides of the latter, the electrifications recorded are also the same on the two sides of the plate; but the boundary-lines of the ions now cross the plate obliquely to its shorter edge (figs. 4, 5 and 6). The positive ion on the longer edge in opposition to the course of the energy is greatest in length, while the negative ion on the same edge of the plate is smallest

* The rectangular silver plate is named, for convenience, the *analysing plate*, or, in brief, the *analyser*.

* That is, where the electrodes are of the same depth and breadth as the cross section of the electrolyte.

in length. The obliquity and the intermedial space between the ions increase as the longer edge of the analyser approaches a line at right angles to the direction of the influence. But at whatever angle the plate is fixed, the boundary-lines of the ions are parallel with the electrodes, and therefore at right angles to the direction in which the energy is transmitted.

When the electric power makes an oblique angle with the *sides* of the analyser, the electrifications recorded present a totally different character. The magnitudes of the same ion and the configuration of its boundary-line are now very different on the two sides of the plate. On the side in opposition to the direct course of the energy, the configuration of the positive ion is markedly convex and greater in magnitude than it is on the reverse side of the plate, where, moreover, the configuration of this same ion is markedly concave (figs. 2, 2). Further, the configuration of the boundary-line of the negative ion on the first-named side of the analyser is concave and smaller in magnitude than on its reverse side, where again the boundary-line of the ion is convex. The intermedial space between the ions increases as the analyser approaches a position at right angles to the right line between the electrodes, and the characteristic boundary configurations become more and more marked. At right angles the positive ion is smaller in quantity, and arranged longitudinally along the centre of the side of the analyser facing the + electrode, while the negative ion on the reversed side is similarly disposed, but generally not so well defined.

The classes of distribution described in these two last paragraphs are named *non-parallel*. The dotted lines in the annexed diagram exhibit the boundary-lines and general characteristics of the parallel and non-parallel distributions.

It is obvious that the results described furnish the data for determining with ease and precision, first, physical differences in parts of an electrolytic field; and, secondly, the direction in which the energy is being transmitted relatively to either side or edge of the analysing-plate, and therefore of its direction in the electrolytic medium. *Many questions have occurred to me in the investigation of which the foregoing method might be expected to afford material assistance. But the one of immediate attraction was whether electricity is endowed, like light, heat, and sound, with the quality of refraction. From the general resemblance of the fundamental laws of the forms of energy, I instituted experiments in the expectation of finding an answer in the affirmative to this question, the better conducting electrolytic medium being taken as the electric analogue of the more rare medium in light.

Refraction.

My first trials were made with double convex-shaped bladders. These gave what I took to be a slight evidence of refraction, though the result was far from satisfactory. Triangular-shaped cells were next employed, made by placing diaphragms of parchment-paper obliquely across the electrolytic cell near its ends. In this way unmistakable proof was obtained of the bending of the energy in passing the line of demarcation of the two media. When the influence passed from one medium to the other perpendicularly, *i.e.*, when the diaphragms were parallel to the plane of the electrodes, no refraction whatever took place.

On further consideration the arrangement which appeared less open to objection, and, at the same time, the most simple and theoretically the best, was a *refracting cell*, having parallel sides of some material permeable to the electric influence. In the first instance parchment-paper was the material employed. Two sheets of this substance were fixed in a vertical position across an electrolytic cell, 380 millims. long, 128 millims. broad, and 128 millims. deep, at an angle of 45°. They were parallel to one another, 76 millims. apart, but equidistant from the respective ends of the cell.

An unit current was employed, and copper electrodes of the breadth and depth of the outer or transmitting cell. A 1 per cent. solution of copper sulphate was placed in the inner or refracting cell, and a concentrated solution of the same salt in the transmitting cell. On placing successive analysers* lengthwise in several parts of the *central line* joining the electrodes, parallel distributions were recorded by all the plates in the transmitting cell, but the one in the refracting cell recorded a non-parallel distribution of a most pronounced character, and it was evident from the degree of curvature of the ions that the course of the energy on passing into the medium of less conductivity had bent out of its original course some 20°.

The difficulty of keeping the parchment diaphragms as rigid as was necessary for a more extended study of this phenomenon of refraction led to their substitution by others of unglazed earthenware. These consisted of the sides of a large rectangular porous cell ground to as uniform a thickness as possible. With this alteration, but with all the other above-mentioned conditions the following experiments were made.

Analysers were successively placed in the positions (all perpendicular to the electrodes) shown in the annexed diagram, exhibiting a horizontal section drawn to about one-fifth the scale.

The analysers, *a*, *b*, *c*, *d*, 2 millims. from electrodes, recorded parallel distributions.

The analysers, *e*, *f*, *g*, *h*, 2 millims. from diaphragm, recorded not absolutely but very nearly parallel distributions. This slight non-parallelism was not noticed in the analogous experiment with the parchment diaphragms, and I am disposed to attribute it to a greater diffusion in this case occasioning a less sharp line of demarcation between the media.

The analyser, *i*, midway between the diaphragms, recorded a non-parallel distribution of a most pronounced character. The degree of curvature showed that the energy had been refracted through some 30°, while the position of the ions proved that the bending was towards a perpendicular to the refracting surface. Furthermore, the symmetry of the curve showed that the plane of refraction was the same as that of the incident energy.

The analysers, *j*, *k*, indicated a result almost identical with *i*.

The analysers, *l*, *m*, showed a much smaller deviation from the original course of the energy.

(*To be continued.*)

* Communicated to the Royal Society, for A. Tribe, by Dr. Gladstone, F.R.S., June, 1881.

* Unless the contrary is stated, it is to be understood that analysers 40 × 7 millims. were used, and placed in the electrolyte with their shorter edges upright.

FERGUSON AND KEMPE'S AUTOMATIC REGISTERING STAMP.

THE registration of the number of letters or circulars which are sent out from an office or house of business is often required; hitherto no means other than that of actually counting has been devised for the purpose. Messrs. H. Ferguson and H. R. Kempe have recently invented and patented a simple apparatus for automatically effecting the registration either electrically or mechanically.

When letters pass through an office they are impressed with stamps for obliterating, dating, and other purposes by means either of a hand or a lever stamp. Messrs. Ferguson and Kempe take advantage of this fact, and mount either the pad for inking the stamp or the pad on which the letter is placed to receive the stamp, on spring supports, and provide electrical contacts so arranged that when the pad receives the pressure of the stamp, a current of electricity is transmitted to an electrical counter, which is thereby moved one division. When the stamp is worked by a lever the contacts are arranged to be operated by the movement of the lever, the pads in that case not requiring the elastic supports above referred to. In cases where it is inconvenient to employ electricity for conveying the counting movement, the counter is constructed in combination with the hand stamp itself, and is worked mechanically in the following manner:—The stamp is fitted so that it can slide a little longitudinally in its handle, pressing it forward by a spring. Within the upper end of the handle is placed a small mechanical counter, the pawl which works its ratchet being connected to the sliding stamp, so that every time the stamp makes an impression the counter ratchet is moved one tooth. As for each act of stamping it is usual to subject the stamp to two pressures, one on the inking pad and one on the letter, the ratchet wheel of the counter is made with double the usual number of teeth, so that the two successive impulses move the counter only over one division.

Fig. 1 represents an arrangement of inking pad working in electrical connection with a counter. The pad is mounted on a hinged board which is pressed upwards by a spring against a stop. When the pad is pressed down by the act of inking a stamp, the upper spring is brought in contact with a lower spring. These two springs (seen in the small figure), which are fixed on a base of wood, are connected by conducting wires through a battery with an electrical counter. Every time the pad is depressed by the act of inking a stamp, a current of electricity is transmitted, which actuates the counter. When the stamping is effected by a lever, the electrical contacts are connected to the lever.

Fig. 2 is a vertical section of a self-registering hand stamp. The stamp is fixed on a stem which is fitted to slide in the handle, B, and is pressed down by a spring, its down stroke being limited by stop pins working in a slot of the handle. On the handle is screwed a hollow cap, D, containing within it the counter, C, which can be inspected by unscrewing the cap. The first wheel of the counter is worked by a pawl lever from the sliding stem, *a*, of the stamp, and this wheel has 20 teeth, the unit barrel on which it is fixed having, however, only 10 divisions. The barrels for the higher denominations are worked by gearing from the first in the usual way. Thus every time the stamp is subjected to pressure, the first wheel is turned one tooth, and the unit barrel is therefore turned half a division. For each stamping operation the stamp is twice subjected to pressure, once on the pad for inking it, and once for delivering the ink on the letter or object to be marked or obliterated. The counter therefore records the number of double strokes of the stamp, and therefore the number of single applications for marking or obliteration. The cap, D, is smooth and rounded externally so as to receive the pressure of the hand for inking and stamping, and it is made of the laterally bulged

FIG. 1.

[...] shown, so that it presents considerable [wid]th to receive the pressure, and that it can [be h]eld firmly in the hand.

FIG. 2.

[W]e may remark that the apparatus shown by [these fi]gures is manufactured by Messrs. Elliott Bros., [Ch]aring Cross.

Notes.

INVESTIGATIONS ON THE POTENTIAL DIFFERENCE OF TWO METALS IN CONTACT WITH EACH OTHER.—By H. Pellat.—In all methods, including that of the author, the apparent potential difference of the metals is measured, *i.e.*, the difference of the electric strata which cover them when in contact. It varies with the physical and chemical state of the surface. Thus the potential difference $Cu \mid Au = 0{\cdot}137$ against that of a Latimer Clark element when the copper has been cleaned with tripoli and washed with absolute alcohol. If the copper is exposed to sulphuretted hydrogen after washing in alcohol, it is $= 0{\cdot}201$. The colour shows that the change has attained its maximum long before the superficial stratum has reached the thickness of a wave-length. A zinc plate rubbed with fine emery paper, and washed with alcohol, gives with gold $Zn \mid Au = 0{\cdot}698$. After 14 days it has fallen to 0·523, though the zinc is still bright. After again polishing with emery, and washing with alcohol, 0·606; and if these operations are again repeated 0·738, which figure sinks in time to 0·690. If the plate is again treated with emery and alcohol, the figure becomes not 0·607 as before, but 0·693, or greater than before, after similar treatment. The author therefore concludes that this change is not due to a chemical modification, but to a mechanical hardening of the surface. With other metals the author has observed an increase of positivity effected by hardening, which is very transient if superficial, and more permanent if it penetrates deeper. Zinc shows this most strongly, copper less, and lead less still.

In indifferent gases the apparent potential increases with an increasing pressure, and on its removal returns to its original value. The variations do not exceed at most $\frac{1}{35}$th of the total value, and are greater in oxygen than in common air, but smaller in carbonic acid and in hydrogen. At a pressure of 20 to 30 mm. of mercury the influence of the nature of the ambient gas is scarcely perceptible. At the pressure of the atmosphere oxygen gives smaller values than air, nitrogen, or carbonic acid. Hydrogen has the same effect as air at from 20 to 30 mm. The influence of a change of pressure, or of the substitution of one gas for another, does not take place immediately, but gradually, so that the difference of potential is due, not directly to these changes, but to an alteration of the surface.

According to Thomson, two metals plunged into one liquid are at the same potential level. Then the electromotive force of an element of two metals, M and M^1, and a liquid, F, must be equal to the potential difference of the two metals. The author has measured the latter directly, and the former by always employing metals in the same surface conditions as in the first measurements. For this purpose he introduced a drop of the liquid between the two plates, and measured the electro-motive force. According to the author the apparent potential difference of the metals, gold, silver, lead, zinc, brass, copper, the same as that of an element formed of these metals (unchanged), and a drop of alcohol. With very hard zinc the apparent potential difference and electro-motive force $Zh \mid Au = 0{\cdot}70$; with softer zinc 0·60.

With water and dilute acids the surface of the metals is acted upon so rapidly that no comparison is possible.

If G is the gas surrounding the metals, the potential difference between two metals covered with the same, M and $M^1 = G \mid M + M \mid M^1 \mid M^1 \mid G$; the electro-motive force of the metals with one liquid F; $F \mid M + M \mid M^1 + M^1 \mid F$.

According to the experiments, if M and M^1 are of like value, both these expressions, are identical, changing with M and M^1. The author suggests that the constant value of these two expressions represents the true potential difference (common to both) of the metals M and M^1.—*Wiedemann's Beiblätter.*

ON THE INFLUENCE OF PRESSURE UPON THE ELECTRIC CONDUCTION-RESISTANCE OF METAL WIRES.—By O. Chwolson.—Wires of copper, brass, and lead were subjected to pressures up to 60 atmospheres in a piegometer, the changes of resistance being determined by means of Jacobi's mercurial rheostat (see *Carl's Repertorium*, 14, p. 1). The introduction of the rheostat was effected in a peculiar manner, for which the reader is referred to the original memoir. The pressures were applied at 4° C. and at the temperature of the room. At 4° C. the temperature of water remains unchanged on pressure.

Copper 0·4 mm. in thickness. At 4° C. and at a pressure of 1 atmosphere there was a relative decrease of about 0 000 001 3. At 17° C. an increase of resistance, *i.e.*, a predominance of the thermic action over the mechanical in consequence of the warming of the water.

Brass 0·463 mm. in thickness (63·66 copper, the rest almost entirely zinc). At 4° C. and a pressure of 1 atmosphere, a relative decrease of resistance of about 0 000 000 11. At 17·4° C. an increase of resistance. Here also there is a predominance of the thermic action.

Lead, 1·85 mm. in thickness. At about 7° C. a relative degree of resistance of about 0 000 012, or ten times more than in case of copper and brass. At 17° C. there is still a decrease, though smaller. Here the mechanical action predominates over the thermic.

For the brass wire the following determinations were made:—

The coefficient of elasticity, $E = 526·70\, r^{-2}$ kilo, r expressing the radius of the wire in millimetres.

The coefficient of tension, $C = 9·755\, r^{-4}$ kilo.

The ratio of the transverse contraction to the expansion in length $w = 27\, r^{2}\, ^{-1}$, the action of stretching upon the resistance of conduction. The relation σ of the relative change of resistance to the relative change of length, $\sigma = 2·305$.

The radius: $0·2326 > r > 0·2294$. From the changes of resistance found on stretching and pressing were deducted the portions due to the changes of form.

Supposing that the changes in density and length take an equal share in the change of the specific resistance, this latter may be regarded as proportiona to the change of the specific volume.—*Wiedemann's Beiblätter.*

ON THE ELECTRO-MOTIVE FORCE OF NON-CONSTANT ELEMENTS.—By A. Naccari and G. Guglielmo.—According to Exner in non-constant elements the electro-motive force is independent of the nature of the electro-negative polar plate, and is always = 0·73 D. These assumptions have been already refuted by Beetz. If the electro-motive force is greater or smaller it is said to be derived from the oxygen dissolved in the water, and from the diffusion of zinc vitriol to the negative plate. The liberation of hydrogen is supposed to be without influence upon the electro-motive force, just as the intensity of the current in a closed circuit.

The authors have experimented with a Mascart's electrometer and with a tilt resembling that designed by Exner, by which the current can be interrupted at a given moment and the poles of the element can be connected with the electrometer quadrant. The authors examined:

1. The influence of the positive plate at which the hydrogen appears. In all the elements the electrodes were contained in two vessels, connected by a syphon 36 centimetres long and 14 internal diameter, closed at each end with parchment paper. The zinc was completely amalgamated; the dilute acid contained one measure of concentrated acid and 20 measures of water. The resistance was changed. If negative plates of different materials were employed the electro-motive force amounted to:

	Platinum.	*Platinised.*	*Carbon.*	*Copper.*
Open element	1·41	1·56	1·38	0·96.
Strongest current	0·60	0·71	0·44-0·30	0·53.

The material of the electrode is, therefore, of the greatest importance.

2. The influence of the intensity of the current appears on the introduction of resistances, increasing or decreasing in such a manner that the electro-motive force decreases with the increasing power of the stream and inversely. With platinum this change takes place very rapidly on a change of intensity; with carbon very slowly; with platinised platinum the electro-motive force sinks little below the calculated value 0·75; even when the current of two Bunsen elements is introduced along with the current of the element experimented with.

3. The influence of the oxygen dissolved in water. There was used: *a.* a perfectly closed element in which no air could be absorbed; *b.* acid, which had been subjected to prolonged boiling, was poured, hot, into the glasses of the element; *c.* the acid, during the current, was kept at about 100° C. at the negative electrode; *d.* a current was passed for 21 hours through the element, so that any oxygen in solution might be consumed. In all cases, the electro-motive force rose with the increasing resistance above 0·73. If a current of air, hydrogen, or carbonic acid was passed by the negative electrode after the element had been closed for a long time, the electro-motive force increased in every case. The gases act all alike, removing probably the small bubbles of hydrogen adhering to the electrode.

Results quite analogous to those mentioned under 1 and 2 appeared when, instead of plate-shaped electrodes, wires were, with carbon electrodes, carefully purified with nitric acid and water, and heated to 100° C. with a platinum plate used instead of the copper plate in a Daniell's element, at least for the first. With a point of platinised platinum, the electro-motive force sinks to 0·64.

4. Influence of sulphate of zinc. A zinc-carbon element carefully put together had when open the electro-motive force 1·36, but when closed 0·32. A careful chemical examination of the solution at the carbon showed not a trace of zinc. The sinking of the electro-motive force to 0·32, far below the theoretical value, can therefore not depend on the diffusion of the sulphate of zinc.

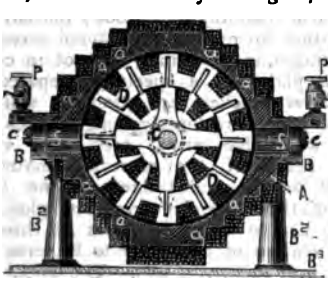
Hence, contrary to Exner's representations, the changes of current intensity may depend upon the known secondary phenomena in the element during electrolysis.—*Wiedemann's Beiblätter.*

THE PRINCE OF WALES AND TECHNICAL EDUCATION.—On Monday, July 18th, the Prince of Wales, who was accompanied by the Princess, laid, in Exhibition Road, South Kensington, the foundation stone of the central institution of the City and Guilds of London Institute. The ceremony took place in a spacious marquee, where there was an elevated dais covered with crimson cloth, in the centre of which there was suspended a polished Cumberland shap granite pillar, which had to be lowered on to a granite pedestal beneath. It appears from the plans of the architect,

Waterhouse, that the building will have a feet, and five storeys, all but the top one 5 ft. 9 in. from floor to floor; that the en- ›e approached by about sixteen steps from Road, through a large and handsome hall, ft. 6 in., the groined ceiling of which will ed by four pillars, one of which was the ft set on the above day by the Prince of t there will be two lecture theatres, with rooms behind them, each capable of holding s; that on the first floor there will be a t. by 33 ft.; and that, among other pro- technical or scientific education, there will l laboratories 76 ft. by 50 ft. in extent. The is estimated by Mr. Waterhouse at about

›R IRA REMSEN, of Johns Hopkins Univer- dertaken some novel experiments to ascer- er the chemical behaviour of a metal is in luenced by magnetic action, and has arrived hich are of considerable interest. His best obtained by placing a shallow vessel of thin ning a solution of copper sulphate, over the nagnet. Out of the magnetic field the solu- deposit upon the iron vessel a uniform copper. When brought within the field of it magnet capable of supporting twenty-five es (fifty-five pounds) the copper was de- a fairly uniform way on the entire plate, ie lines marking the outlines of the poles. were sharply marked as depressions in the When, instead of a permanent magnet, an gnet was employed, the iron vessel and cop- n being the same as before, a more striking observed. There was no deposit of copper w space marking the outline of the poles. outline (over the poles) the deposit was rm. Outside the blank outline marking the pper was deposited in irregular ridges run- ht angles to the lines of force, and apparently with the lines marking the equipotential By increasing the power of the electro- action is intensified and the area affected ed, the largest circles obtained in Prof. experiment being nearly four inches in dia- ie cause of the phenomenon has not yet nined, though the effects are obviously to be the influence of the magnetism on the iron i the liquid, or on both together.—*Scientific*

T (No. 243,264, dated Oct. 23, 1880) for a ectric machine has been taken out in the tes by Mr. C. A. Hussey, of New York. In ne, which is shown by the figure, the arma-



mpletely inclosed in a hollow field-magnet, iting wire is wholly external to the field- There is an electro-magnet composed of a ternally circular form with wire wound over , without passing through its interior, from end to end, and inclosing it, save at certain places de- signed to form poles or consequent points.

MR. JOHN TROWBRIDGE has just completed the fol- lowing experiment in the physical laboratory of Harvard University. He submitted a bar of iron to a great cold of 60° C. below zero, obtained by evaporating CO_2. He proved that the decrease of magnetism, suspected by Wiedemann, if the bar be at a lower temperature than that allowing magnetic im- pregnation, is indeed a demonstrated physical fact. The bar, which had been magnetised at 20° C. below zero, had lost almost two-thirds of its magnetism after 47 minutes of exposure to this cold. He also observed that, by keeping a bar of steel for a certain time at a temperature of 20° C., 50 per cent. of its primitive magnetism was restored.—*Science*.

A SERIES of technological handbooks, edited by Mr. H. Truman Wood, B.A., are about to be published by the Society of Arts. Amongst them will be "Tele- graphs and Telephones," by W. H. Preece, F.R.S., Memb. Inst. C.E., Electrician to the General Post Office.

AMERICAN CABLE COMPANY.—The shore end of the second cable of this company was successfully landed at Whitesand Bay, Land's End, on the 21st ult., by the telegraph steamer *Faraday*. It is expected that the main portion will be completed during October next.

THE UNITED TELEPHONE COMPANY *v.* MOSELEY AND SONS.—This was a motion, in the High Court of Justice, on July 21st, before Mr. Justice Fry, to restrain Messrs. Moseley and Sons, of Manchester, until the trial of the action or further order, from manu- facturing and selling carbon transmitters which were alleged to be infringements of a patent granted to Mr. Edison, on the 30th July, 1877. The Edison Telephone Company was formed in August, 1879, for the purpose of bringing into practical use in this country the instrument known as the Edison Loud-Speaking Telephone, and that company afterwards became amal- gamated with the Bell Telephone Company, under the name of the United Telephone Company. The plain- tiffs alleged that Mr. Edison was the original inventor of the method of producing undulatory electric currents in wire by the human voice so as to reproduce the sound, and that, prior to his patent, no person had ever employed carbon for that purpose. It appeared, how- ever, that Mr. Edison had himself supplied certain publications in the United States with a description of a part of his invention, and that description having been copied into scientific journals here some weeks before Mr. Edison took out his patent, the Attorney- General's fiat was obtained enabling the inventor to disclaim so much of his specification as had been inva- lidated by the premature publication, but a condition was imposed that proceedings should not be taken in respect of transmitters actually made and completed before the date of the fiat. The defendants alleged that the carbon transmitters of which the company com- plained were made before the date of the fiat, but there were no numbers or identifying marks to distinguish them from instruments made since. Mr. Aston, Q.C., and Mr. Cozens Hardy appeared for the plaintiffs; and Mr. Ford North, Q.C., and Mr. Macrory for the defendants. It appeared in the course of the argument that the evidence in support of the plaintiff's case was incomplete, and application was accordingly made for the motion to be postponed for a week, but at the sug- gestion of his lordship, it was arranged that it should stand till the trial of the action.

IMPORTANT TELEPHONE DECISION.—Judge Lowell, of the United States Circuit Court, Boston, Mass., rendered an important decision on the 27th June, in

which he virtually confirms to the American Bell Telephone Company *the exclusive right of talking over a wire by electricity*. The suit in question was brought by the American Bell Telephone Company against Albert Spencer and others, and the decision, as we understand, is based on the fifth clause of Bell's claim, patent of February 14th, 1876, as follows:—"5. The method of, and apparatus for, transmitting vocal and other sounds telegraphically, as herein described, by causing electrical undulations, similar in form to the vibrations of the air, accompanying the said vocal or other sounds, substantially as set forth." The court decides that the specific method of producing the electrical undulations employed by the defendants is different from the Bell plan. The defendant's device is made on the principle of the microphone, which has been very much improved since the date of the first Bell patent. The judge says:—"If the Bell patents were for a mere arrangement or combination of old devices to produce a somewhat better result in a known art, then, no doubt, a person who substituted a new element not known at the date of the patent might escape the charge of infringement. But Bell discovered a new art—that of transmitting speech by electricity, and has a right to hold the broadest claim for it which can be permitted in any case—not to abstract the right of sending sounds by telegraph without any regard to means, but to all means and processes which he has both invented and claimed." Judge Lowell pays a just tribute to the learning and ingenuity of Professor Reiss, but holds that his telephone of 1860 was an imperfect instrument, which, although some sounds of the voice could be sent, was still incapable of completely transmitting articulate speech. This differs from accounts we have had of the Reiss telephone, and perhaps the entire evidence in respect thereto was not brought out before the court. It may equally be said of Bell's telephone, that while it is a good receiver it is a poor transmitter—so poor that its use has been almost abandoned in favour of superior instruments such as the Blake or the Edison. If we had to rely only on the Bell instruments the telephone would be a nuisance, and the widespread use of speaking telegraphy now enjoyed could never have been realised.—*Scientific American.*

Electric Light in the City.—The district allotted to the Electric Light and Power Generator Company has, we believe, not yet received its proper installation. What is the matter? The chairman of the company, at the meeting on the 20th ult., spoke of the care which had been bestowed to make the experiment *that evening* a success. The lamps put up for use are, we understand, of three kinds—the Weston, the Lontin, and the Harding lamps being each represented.

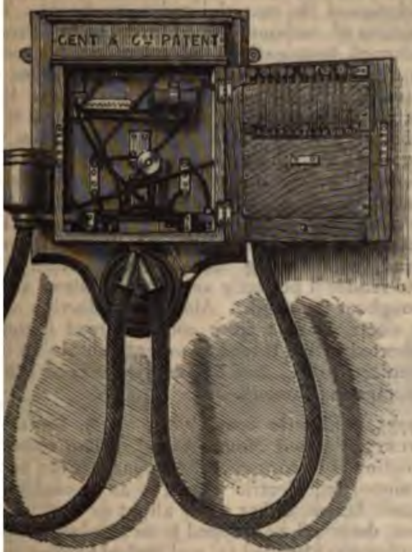
The New York *World* says that it believes that Mr. Gould and the American Cable Company working together will establish on a sound basis an economical and efficient system of American ocean cables. It is stated that this company has ordered a third cable to supplement the one just finished and the second, which the contractors will complete in the autumn. There is, we have reason to believe, no truth in the statement.

International Electric Exhibition.—A memorial, signed by the Archbishop of Canterbury, Lord Shaftesbury, the Bishop of London, the Lord Mayor, the Rev. C. H. Spurgeon, Mr. Samuel Morley, M.P., and 22 other members of Parliament, and 7,296 members and friends of the Working Men's Lord's Day Rest Association, has been presented to the Prime Minister, expressing regret that it is proposed to open the English exhibits, including those of the Government, on Sunday at the International Electric Exhibition to be opened in Paris the first week in August. The memorialists submit that the public opinion of Great Britain has always been emphatically opposed to the opening of Exhibitions on Sunday; that all our own great Exhibitions have been entirely closed on the Sundays; that at previous Exhibitions in Paris and Vienna the English and American exhibits have been closed almost without exception; and that the Philadelphia Exhibition in 1876 was entirely closed on Sunday. The memorialists express a hope that Her Majesty's Government will order that no one shall be employed on Sunday in connection with the exhibits of the British Government at the forthcoming Electric Exhibition. Mr. Gladstone has sent the following reply to Lord Shaftesbury:—"10, Downing Street, Whitehall, July 20th, 1881. My Lord,—I am directed by Mr. Gladstone to assure you that the memorial which you have done him the honour to forward to him on the subject of the International Electric Exhibition shall have careful consideration.—I am, my Lord, your Lordship's obedient servant, J. A. Godley."

It is announced that the next annual general meeting of the British Association for the Advancement of Science will be held at York, commencing August 31st. The president elect is Sir John Lubbock, Bart., M.P., F.R.S. The following notice to contributors of memoirs has been issued:—"Authors are reminded that, under an arrangement dating from 1871, the acceptance of memoirs, and the days on which they are to be read, are now, as far as possible, determined by organising committees for the several sections *before the beginning of the meeting*. It has therefore become necessary, in order to give an opportunity to the committees of doing justice to the several communications, that each author should prepare beforehand an abstract of his memoir, of a length suitable for insertion in the published Transactions of the Association, and the Council request that he will send it, together with the original memoir, by book-post, on or before August 1, addressed thus:—'General Secretaries, British Association, 22, Albemarle Street, London, W. For Section............' Authors who comply with this request, and whose papers are accepted, will be furnished *before* the meeting with printed copies of their reports or abstracts. If it should be inconvenient to the author that his paper should be read on any particular days, he is requested to send information thereof to the secretaries in a separate note. G. Griffith, Acting Secretary, Harrow, Middlesex."

Messrs. J. T. Gent & Co., of Leicester, have recently brought out the form of telephone shown by the figure. The instrument is contained in a neat walnut case, to the cover of which, leaving a small space between, is attached a diaphragm of wood; the cover has the usual aperture for receiving the sound waves. Across the diaphragm, in proximity, but not in contact, are fixed thin plates of a specially prepared material To the cover brackets are attached, which carry a spindle, on which are loosely hung (vertically or horizontally) adjustable arms, each arm carrying a plug or pencil of the aforesaid material; these latter rest on the plates fixed to the diaphragm. 12 to 16 of the suspended arms and plugs are used, and these are arranged in series of three or four, so that a current of electricity to traverse the whole must pass over successive sets. The object of using a row of plates and arms is that the whole of the vibrations of the diaphragm may be utilised, resulting, it is stated, in proportionately powerful undulatory currents. One end of the row of plates is connected to a battery, the other end to an induction coil. Any form of telephone receiver may be used with the transmitter.

e tube is used to contain the wires and protect m injury, thus obviating one of the objections



connections between receiver and transmitter. ic switches and bell form part of the apparatus. ingement of the transmitter and the employ- a flexible tube to protect the wires from injury chief peculiarities and points of novelty in the rument.

ave received a prospectus of the "Telephone School," Upper Norwood, of which Mr. C. E. is the electrician and principal. Practical on will be the object in view, and to this end scription of telephone as well as all apparatus ning thereto, for both exchange systems and communication, will be provided, and so far as in duplicate, so that pupils will have the ity of dissecting and reconstructing the same. nd materials for making those parts of the apparatus that can be made by hand will be d, and every facility given for conducting ex- ts by those pupils whose tastes incline them in ction. Complete working telephone exchanges the various systems in use in different countries in practical working order, and pupils will be to every department of their manipulation. poles, wire, insulators, brackets, &c., will be for outdoor construction, concerning which instruction will be given. Pupils will then be to avail themselves of testing their own abilities ersonal supervision. Testing apparatus will provided, with which pupils will be taught to the electrical resistances of the various instru- batteries and wires, and the more important f localising faults, both in the apparatus and ine wires. Pupils desirous of extending their and practice to telegraphy will be afforded cility for doing so. While the course of instruc- be essentially practical the theoretical will not ected. All the leading scientific journals will ded. It will thus be seen that the course of on will be very complete. The school, it may d, is under influential patronage, the leading e telephone world, including the chairmen of the elephone companies, being amongst the patrons.

contract concluded between the German Tele- Company in Berlin and the German Union Telegraph Company, a submarine cable is to be laid between Emden, on the Hanoverian coast, and Valentia, in Ireland, for the purpose of connecting Germany directly with the United States. At Valentia the new cable will be attached to and continued by the Anglo-American one, which will thus form a second wholly submarine electric tie between America and the Continent of Europe. The cost of the new Emden-Valentia cable, which, it is hoped, may still be laid in the course of this year, is calculated at about £165,000, and will be covered by the issue of 5½ per cent. preference shares.

THE BROOKS UNDERGROUND SYSTEM.—The laying of the second portion of the telegraph line (insulated by the above system) between Waterloo and Nine Elms is now accomplished, and the Post-office authorities are having their wires placed in connection therewith. We hope to publish the tests taken in our next issue.

A VOLTAMETER for measuring strong currents, and devised by Mr. G. M. Hopkins, has recently been described in the *Scientific American*. The action of this instrument depends on the heating effect of the current on a thin platinum or copper wire, the linear expansion of the wire giving the index more or less motion according to the strength of the current. The general construction of the apparatus is as follows:—A vertical plate of vulcanite supports a horizontal stud, upon which are placed two metal sleeves having a glass lining. To one of these sleeves is attached a counter-balanced arm, carrying at its upper end a curved scale, having arbitrary graduations determined upon by actual trial under approximately the same conditions as the instrument will be afterward subjected to in actual use. The other sleeve carries a light counter-balanced metal index, which moves in front of the curved scale. Each sleeve is provided with a curved platinum wire arm, dipping in mercury contained in an iron cup secured to the base. Two platinum or copper wires are stretched along the face of the instrument, and attached at one end to hooks passing through an insulating post, and after passing once around their respective sleeves on the index and scale, are attached to spiral springs, which in turn are connected with wire hooks extending through an insulating post projecting horizontally from the vulcanite plate. Under each wire there is a horizontal metal bar communicating under the base with one of the binding posts. The two other binding posts are connected separately with the two mercury cups. It will be seen that with this construction the expansion of the rear wire will move the scale, while the expansion of the front wire will move the index. In order to apply the current to any required length of wire, there is upon each of the horizontal bars a clamp, which may be placed anywhere along the bar and screwed up so as to clamp both wire and bar. Usually the current to be measured will pass from the battery or machine to one of the binding posts, thence to the forward horizontal bar, thence through the expansion wire connected with the index, through the sleeve of the index, and finally through the mercury cup to the other binding post. It will be observed that both scale and index will be moved in the same direction by the expansion of their respective wires, and that the atmospheric temperature affects both alike. This being true, it is unnecessary to take any account whatever of external temperature. The apparatus is inclosed in a glass case to prevent the cooling action of the draughts of air. By connecting the index expansion wire with a battery having an electro-motive force of one volt, the deflection is very slight, even with a very fine wire, but in a stronger current from a battery having an electro-motive force of five volts and upward, slight variations will be readily indicated.

New Patents—1881.

3049. "Electric lamps." F. W. HADDAN. (Communicated by L. G. Woolley.) Dated July 12.

3053. "Battery telephones, resp transmitters, resp microphones." L. JACOBSON. Dated July 12.

3073. "Improvements in lamp casings or holders for containing and protecting electric light, and in apparatus to be used in connection therewith, the said apparatus being in part applicable for other purposes." D. GRAHAM. Dated July 14.

3122. "Manufacture of electric bridges for lamps." ST. G. L. FOX. Dated July 18.

3129. "Apparatus for the mechanical reproduction of sound." J. J. WALKER. Dated July 18.

3140. "Fac-simile telegraphs." E. G. BREWER. (Communicated by T. A. Edison and P. Kenney.) Dated July 19.

3166. "Electric lamps." W. MORGAN BROWN. (Communicated by G. P. Harding.) Dated July 20.

3177. "Improvements in the insulated coatings and covers or cases for wires and cables for the telegraphic and other analogous purposes, and in the machinery or apparatus employed in applying the coatings to the said wires or cables." T. J. MAYALL. Dated July 21.

3187. "Electric lamps or lighting apparatus." W. R. LAKE. (Communicated by J. V. Nichols.) Dated July 21.

3189. "Improvements in and relating to electric lamp or lighting apparatus, and in the manufacture of portions of the same." W. R. LAKE. (Communicated by H. S. Maxim.) Dated July 21.

3190. "Improvements in fittings for electric lighting apparatus and in the method of converting gas-fittings to such purposes." R. H. HUGHES. Dated July 21.

3214. "Electric lamps." A. M. CLARK. (Communicated by L. J. Bouteilloux and W. Laing.) Dated July 22.

3224. "Improvements in galvanic batteries and in the treatment of solutions therefrom for the recovery of useful products." J. and A. J. HIGGINS. Dated July 23.

3228. "Apparatus for controlling telephonic communications." J. IMRAY. (Communicated by L. A. Brasseur and O. Dejaer.) Dated July 23.

3231. "Commutators for dynamo or magneto-electric machines, or electro-motors." E. G. BREWER. (Communicated by T. A. Edison.) Dated July 23.

3238. "A system of electric contact for electric clocks and for other purposes, and process of purifying mercury employed therein." B. J. B. MILLS. (Communicated by G. Leclanché.) Dated July 25.

3240. "Improvements in obtaining electric light and in the apparatus to be employed therefor." T. E. GATEHOUSE. Dated July 25.

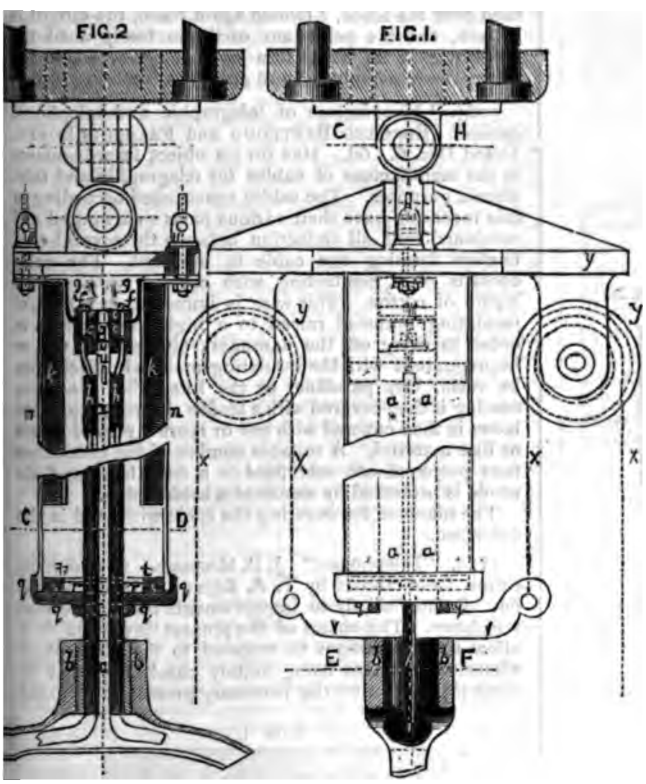
3247. "Self-acting electric clocks." F. F. REID and J. M. VALENTINE. Dated July 25.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1880.

5014. "Electric lamps." J. W. SWAN. Dated Dec. 2. 6d. Relates to incandescent lamps, and consists chiefly of improvements in the carbon conductor itself and in the mode of attaching it to its connections. The inventor claims the formation of the carbon or carbons of an electric lamp from cotton thread converted by the action of sulphuric acid and carbonised by subjecting it to heat in a vessel or receptacle containing powdered carbon or other powder which will prevent the oxidation of the material under treatment. The construction of carbons formed from cotton thread with thickened terminations by wrapping the ends with strips of bibulous paper, muslin, or other suitable material, and then submitting the cotton thread so treated to the action of sulphuric acid, and afterwards carbonising it by subjecting it to heat in a vessel or receptacle containing powdered carbon or other powder which will prevent the oxidation of the material under treatment. Binding the ends of the cotton thread to the conducting wires in a peculiar manner. The production of carbons for electric lamps from cotton thread, compressing the converted cotton thread so as to render it perfectly uniform in texture and section throughout its length. Also the production of carbons for electric lamps from cotton thread flattening the converted cotton thread in order to obtain an increased superficial area. And the construction of the carbons of compound threads.

4755. "Electric lamps," &c. J. A. BERLY and D. HULETT. Dated Nov. 18. 6d. The object of the invention is to construct the apparatus for suspending or supporting electric lamps, so as to enable the said electric lamps (either when alight or not) to be pulled down, detached, or dropped to be regulated, replenished or otherwise attended to, and pushed back or readjusted to their former or any required position, the said lamps being either alight or ready for lighting or otherwise. Fig. 1 is an elevation or general view of one arrangement of the apparatus. Fig. 2 is a longitudinal section of the said apparatus. *a* is a flat bar of metal or other substance, and to which the electric lamps as well as the sliding and movable parts are attached. *b* shows the attachment of the lamp by its coronet, pendants, or other suspending or supporting arrangement to the piece, *a*. *c* is a piece of ebonite or other insulating material attached to the top of central rod, *a*, by means of the key, *d*, the piece, *c*, might be screwed on *a* or fixed to it in any other manner. *d*, key attaching the piece, *c*, to the rod, *a*. *e*, cover, in ebonite or other insulating material, pressing on the two conductor springs, *g*, which they maintain in position by means of the bolts and nuts, *f*. *f*, bolts and nuts securing the conductor springs, *g*, in position. *g*, conductors connecting the circuit wires attached to terminals, *n*, to the electric lamps by means of the strips of metal, *j*, against which they are made to press, and sliding up and down are always in electric communication with the said strips, conveying therefore the currents from terminals, *n*, to the electric lamps by means of the intermediate strips of metal, *j*, and the conducting wires, *h*, and this in whatever position of the movable or sliding portion of the apparatus. *h*, conducting wires attached to the bolts, *f*, and conveying the currents from contact pieces, *g*, to the lamps. *j*, strips of metal electrically connected with terminals, *n*, and against which the friction pieces, or springs, or electric collectors, *g*, always press in the upwards or downwards motion of the sliding or movable part. *k*, slips of wood or other non-conducting material attached to outside tube, *m*, which latter tube incases the whole arrangement and is attached to the ceiling plate. *n*, terminals fixed on ceiling plate, from which they are insulated and receiving the circuit wires. *p*, cover at end of tube, and in which a slot is managed to allow of the passing of the rod, *a*, and conducting wires, *h*, and at the same time acting as a guide to the sliding portion of the apparatus. *q*, india-rubber buffer to prevent the lamp knocking against bottom, *p*, of suspension arrangement in the upwards motion. *r*, india-rubber buffer to prevent knocking of the lamp against cover,

p, in the downwards motion. *t*, iron washer, against which the key, *u*, knocks in the sliding portion's downwards motion. *u*, key across rod, *a*, and extending to the outer tube and acting as a guide to the top of sliding or movable portion of the apparatus. *v*, bottom of rod, *a*, and to which the chains, *x*, are attached. *x*, chains attached to bottom piece, *v*, and receiving at their other ends the counterbalancing weights, keeping the whole of the sliding portion with its attached electric apparatus in constant equilibrium. *y*, pulleys over which the chains, *x*, are running. It will be seen from the foregoing description that in any position of the sliding portion of the apparatus the currents from the circuit wires attached to the terminals, *n*, fig. 2, will be conveyed to the strips of metal,



i, and collected by the friction pieces, *g*, from which through bolts, *f*, to which they are electrically connected, the said currents will be conveyed to the lamps by means of the conducting wires which are attached to the heads of bolts, *f*.

4988. "Electric lamps." KILLINGWORTH WILLIAM HEDGES. Dated Nov. 30. 6d. Relates chiefly to the construction of electric lamps with inclined carbons. Fig. 1 is a front view of an electric lamp according to the invention, and fig. 2 is a side view of the pair of positive carbons. A is the negative carbon lying in an inclined trough or open tube, and butting near its end against an adjustable stop, *a*, so that the carbon descends as that portion of it against which *a* bears becomes consumed. The positive carbons, B and C, meet together at their ends, as shown in fig. 2, and one of these may be smaller than the other, so that the whole of the electrical current may pass through the larger, the smaller carbon becoming gradually consumed with it. The contacts for both the negative carbon, A, and the larger, B, of the positive carbons are made of pieces of metal, D, slightly hollowed to fit over the carbons, and hinged at higher points, *d*, to the troughs in which the carbons lie, the current being led to and from the contact pieces, D, by wires, d^1, escaping the joints of their hinges. The trough in which the carbon, A, lies is suspended by radius rods, E, E, from the upper framing, F, of the lamp to which the troughs for the carbons, B, C, are fixed. In the framing, F, is arranged an electro-magnet, G, having its coil in the lamp circuit, its armature, *g*, is attached to one of the radius rods, E, with a screw adjustment. When the lamp is out of

FIG.1.

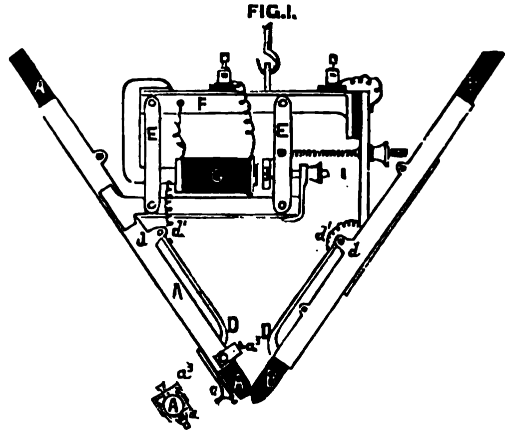
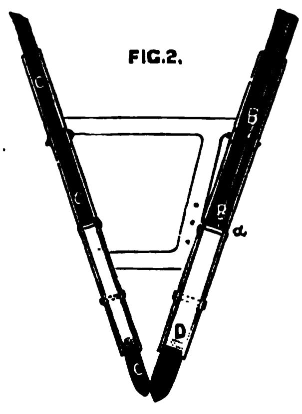


FIG.2.



circuit the end of the carbon, A, butts against the meeting of the carbons, B and C, but when an electric current is passed through the lamp, kindling the carbons where they butt, the electro-magnet, G, becomes excited and attracts its armature, *g*, whereby the end of the carbon, A, becomes separated from B and C, and the arc is established between them. As the carbons become consumed the two, B and C, continue to descend their respective troughs, the end of each supporting the other, and the carbon, A, advances, as permitted by the stop, *a*, so as to present its end at nearly the same distance from the ends of B and C. In order to render the stop, *a*, effective, an abutment screw, a^3, is provided at the upper side of the carbon, A.

The patent also relates to an incandescent lamp in which a carbon has its end resting on a periphery of a chisel-edged metal disc.

5051. "Time-pieces worked by electricity." W. P. Thompson. (A communication from abroad by Monsieur Alphonse Lemoine, of Paris.) Dated Dec. 4. 6d. Has for its object an improved system of electric time keeping, by the aid of an electro-magnet, which gives automatically to the pendulum of the clock a fresh impulse each time that its oscillation fails to attain to a certain amplitude of course. To arrive at this result the current is passed round the electro-magnet, each time that it is necessary, by a piece mounted upon the pendulum and manœuvred by the resistance that the air opposes to it during its oscillation. Fig. 1 shows the front view of the pendulum of a clock disposed according to the invention; fig. 2 represents the side view of the mechanism working the closing of the electric current when that is necessary. *a* is the pendulum furnished at its lowest

FIG.2.

part with a piece, *b*, of soft iron forming the bob or weight; this bob is of soft iron in order to be at any desired moment drawn by the electro-magnet, *c*. Upon the bob, *b*, is a standard, *d*, upon the horizontal arm of which turns a light spindle, *e*, mounted upon a socket, *f*, and furnished at its lower part with a vane or other equivalent piece, *g*, in paper, mica, or other like material. Upon its upper part the pendulum of the clock carries a catch, *h*, which at each double oscillation advances one tooth of the wheel, *i*, which commands the minute hand, and which can be arranged in any convenient manner. Upon the stand of the clock is placed a fixed blade, *k*, communicating with one of the poles of a battery, the positive (+) pole, for example; another blade, *l*, forming a spring, communicates with the electro-magnet, binding it to the negative (—) pole of the battery. As long as the range of oscillation of the pendulum does not descend below the normal limit, the spindle, *e*, passes over the contact spring, *l*, without lowering it, by following the inclined path that the resistance of the air gives it (acting upon its vane). If, on the contrary, the range of oscillation diminishes, the speed of the pendulum diminishes in like proportion, and the resistance opposed by the air to the movement of the vane, *g*, must equally lessen in such manner that the spindle, *e*, approaches the vertical. It then presses upon the contact, *l*, which bends upon the blade, *k*, in such manner that, the circuit being closed, the current traverses the electro-magnet, which becomes active. As this effect is produced before the pendulum becomes vertical, as indicated by the dotted lines in the drawing, the armature or bob, *b*, of the pendulum is attracted, and regains its full range of oscillation under the influence of this impulse; the spindle, *e*, gliding then over the blade, *l* (which again rises), the circuit is broken, and the pendulum oscillates freely until the amplitude of its oscillation lessens again, when the contact is re-established and gives it a fresh impulsion.

5083. "Manufacture of telegraphic and telephonic cables." Edouard Berthoud and Francois Borel. Dated Dec. 6. 6d. Has for its object improvements in the manufacture of cables for telegraphic and telephonic purposes. The cables constructed according to this invention have their various parts so arranged and combined that all induction between the several conductors forming one cable is obviated. The cable consists of a conducting wire covered with several layers of cotton. This wire is immersed in a bath of insulating material raised to a high temperature in order to carry off the dampness of the wire, and to impregnate it with the insulating material, which may be resin, tar, paraffine, or the like; the insulating coating is then covered with a leaden sheathing, and the latter is then covered with one or more layers of cotton or like material. A suitable number of the conductors thus prepared are submitted to a fresh bath, and the whole is protected by means of a leaden pipe.

The machine for covering the cable with lead is also described.

5113. "Telephones." J. B. Morgan. (A communication from abroad by T. A. Edison.) Dated Dec. 8. 6d. Relates chiefly to improvements upon the carbon telephone. The object of the present invention is to allow the diaphragm to respond to the atmospheric vibrations without being unduly checked, and at the same time to insure the necessary pressure and extent

FIG I.

of surface contact between the carbon, or similar material, and the electrodes to produce the corresponding electric changes or undulations in the line. In the figure the diaphragm is represented at *a*, with a suitable case, *b*, and mouth piece, *c*, the diaphragm, *a*, resting upon or being secured at its edges to the said case, *b*. The carbon or similar material for regulating the electric condition of the line is shown at *i*. The carbon,

i, is in a cup, *d*, of insulating material, such as hard rubber. One metallic electrode, *e*, is in the form of a metal rivet that holds the cup, *d*, to the diaphragm; the carbon rests against this. The other electrode is in the form of a platina disc at the end of the screw, *f*, that passes through the spring, *g*, that is connected at its ends to the cup, *d*, so that the proper initial pressure is applied to the carbon by the screw. There is a weight, *h*, carried by the spring, and one wire, *k*, is connected to the diaphragm, and the other wire, *l*, to the spring, *g*.

5137. "Electric machinery and apparatus for the production of light and heat," &c. W. T. HENLEY. Dated Dec. 9. 2s. 8d. Relates chiefly to the dynamo machine described on page 288 of this JOURNAL. It also relates to new electric lamps.

5141. "Magnetic apparatus for separating iron particles from wheat, flour," &c. T. M. CLARKE. Dated Dec. 9. 2d. Has for its object a magnetic apparatus to separate iron particles, such as are very apt to be found in grain, or to fall or break off from machines into the material passing through the mill. In this invention the magnets are made to rotate, forming parts of a roller or cylinder, or series of wheels or cylinders, provided with a stationary or movable scraper or scrapers, brush or brushes, or their mechanical equivalent on the opposite side to that over which the wheat passes, or fixed in such a manner as to remove the iron particles from the magnets as they revolve and prevent said particles from being brought back into the material to be purified. (*Provisional only.*)

5162. "Transmitting and receiving apparatus of printing telegraphs." H. VAN HOEVENBERGH. Dated Dec. 10. The general object of the invention is to increase the rapidity and certainty of operation of type-printing telegraphic apparatus, and to provide improved means of maintaining the synchronism between the transmitting cylinder at the sending station and the type wheel at the receiving station or stations, by causing the same to be regulated or adjusted automatically once during each revolution, instead of at irregular intervals, and at the will of the transmitting operator, as in the apparatus heretofore in general use.

5275. "Electric lighting," &c. DESMOND GERALD FITZ-GERALD. Dated Dec. 16. 2d. Relates to improvements in incandescence electric lamps. When a carbonaceous conductor is employed, and more particularly when this is obtained by the carbonisation of vegetable substance, any required degree of hardness or solidity and of electrical conductivity or resistance, is given to the conductor by treating the vegetable substance or the carbon obtained therefrom with solutions rich in carbon (this element being liberated by subsequent ignition), also with salts of the refractory metals, such as platinum or irridium, and with salts, such as those of magnesium and cadmium, which when decomposed furnish an infusible earth or oxide, the metal, earth, or oxide being obtained in admixture with the carbon. (*Provisional only.*)

5340. "Telephone signal apparatus." WILLIAM MORGAN-BROWN. (A communication from abroad by George Henry Bliss, of America.) Dated Dec. 20. 8d. Relates to telephone signal apparatus, and contains a series of clockworks arranged to run synchronously, and each controlling a signal bell in the circuit so as to allow it to sound only at certain predetermined periods of time, the said periods being different at each instrument, so that only one signal can be operated at any one time, the others then being kept silent by the said controlling clockwork. The clocks are all automatically stopped at the end of an interval of operation, in which each has had its individual period in which the signal could be sounded, and they remain so stopped until it is desired to give a signal at any of the stations, when the instruments are all started simultaneously by electro-magnets acting on the stop mechanism.

City Notes.

Old Broad Street, July 27th, 1881.

THE DIRECT UNITED STATES CABLE COMPANY, LIMITED.—The report of the directors for the six months ending June 30th, 1881, states that the revenue for the half-year, after deducting out-payments, amounted to £93,581 14s. 8d. The working and other expenses for the same period, including interest on debentures, and income tax, &c., amounted to £26,871 12s. 7d., leaving a balance of £66,710 2s. 1d. as the net profit for the half-year, making, with £3,116 17s. 7d. brought forward from the previous half-year, a total of £69,826 19s. 8d. Three quarterly interim dividends of 1¼ per cent. each, amounting to £45,532 10s., have been declared and paid at the usual times during the financial year, and a final dividend of 5s. per share is now proposed, making, with the three interim dividends, 5 per cent. for the year, being a total distribution of £60,710. The appropriation of the above balance of £69,826 19s. 8d. on the revenue account is thus shown:—Interim dividend for quarter ending 31st March last, £15,177 10s.; final dividend now proposed, £15,177 10s.; carried to reserve fund, thereby increasing it to £235,000, £32,292 9s.; carried forward to next account, £7,179 10s. 8d. The cables are now, and have been since the last report, in good working order.

EASTERN TELEGRAPH COMPANY, LIMITED.—The eighteenth half-yearly ordinary meeting of the shareholders of this Company was held, on July 14th, at the City Terminus Hotel, Mr. J. Pender, M.P., in the chair. The chairman, in moving the adoption of the report (*see* TELEGRAPHIC JOURNAL, July 15th), said that the revenue showed an increase of £10,964. This increase was to some extent accounted for by the improved return upon their investment in the South African Company. The ordinary expenses of the Company showed a decrease of £883 over those of the last half-year, but the expenses of the former period included charges which did not come into the figures of 1880. The accounts were very fully set out, every item of importance being stated in them. Generally on these occasions he had been able to congratulate the proprietors upon the fact that their cables were in perfect working order, but he was sorry to say that the two Bombay cables were not now in working order. It was believed, however, that the damage was but a short distance from the shore, and might easily be repaired. Beyond delay in the traffic, he did not see in the stoppage any cause for uneasiness. Submarine telegraphy was always more or less a speculative investment. They knew that their cables were at the bottom of the sea, but they were uncertain as to what the bottom of the sea was. Within the last ten days the French cable was repaired, and it was now in good working order. They had also within the last month repaired a cable from 2,000 fathoms of water, so that whilst their property was speculative, their experience was leading them to the knowledge of how to deal with it. Repairs was always a large item, but if they took them from the commencement, they would find that they had been something

under 10 per cent. on the capital. He had to congratulate the shareholders upon the fact that they were able to pay some slight addition to the dividend, and he hoped that it might be still further increased. To enable them to earn a steady dividend, and to give their property something like a good footing in the general market, it was most important that they should add to the reserve fund. In the early stages of the Company they were not in a position to add largely to the reserve fund; but the average additions since the commencement had been about £41,000. They felt that they were fairly represented in that respect, but they had not sufficient to enable them to say that they were independent. It was therefore desired that the policy of adding to the reserve fund should continue. The motion was seconded by the Marquess of Tweeddale. In the course of a brief congratulatory discussion which followed, it was mentioned by the chairman that the cost of repairing the Bombay cable might be about £5,000. Owing to combination with other companies, the break had not caused any stoppage of their business. The resolution was adopted unanimously, and a vote of thanks to the chairman closed the proceedings.

THE GERMAN UNION TELEGRAPH AND TRUST COMPANY.—An extraordinary general meeting of the members of the German Union Telegraph and Trust Company, Limited, was held on Monday, July 18th, at the offices of the company, Old Broad Street, "for the purpose of considering proposals of the German Union Telegraph Company of Berlin for establishing a new cable between Germany and Ireland, and raising capital for the purpose by the issue of preference shares, and passing such resolutions with respect thereto as the meeting may deem expedient." Sir James Anderson presided, and stated that the object of the proposed new cable was to give Germany direct communication with America, which the German Government and their telegraph administration particularly desired to have. The German Union Company of Berlin had undertaken to bring a cable connecting Germany with Valencia, and to have one of the Anglo-American Company's cables to go thence to America. In exchange the concessions offered to the German Union Company contained in it some clauses which gave them the preference of laying any further cable which might be required to meet the wants of Germany. It would also give the German Union Company a duplicate cable. The directors of this company concurred with the directors of the German Union Company in laying the cable and securing themselves from opposition. For all purposes Germany by the new cable would have as direct communication to America as had France and England. No doubt it would affect the ordinary shares of this company, but not so much as it would if it were a rival cable. The founders of the original company had the right to a full half of the new shares, and if they took them, as it was assured they would, then the shareholders of this company would be allowed to apply for the other half, *pro rata*. The directors of this company considered that the investment was a fair one. The proposed capital was £165,000, and powers would be taken to raise that amount in 5½ per cent. preference shares. He concluded by moving the following resolution:—"That this meeting having considered the proposals of the German Union Telegraph Company of Berlin with respect to the laying of a new cable between Germany and Valencia, and the chairman's explanation in regard thereto, it is hereby resolved that such proposals be generally approved, and that the directors of this company be authorised to communicate this resolution to the Berlin Company, and to make such arrangements with that company with respect to the issue of the new shares as they may think expedient, and to secure for the shareholders of this company the opportunity of subscribing for such of the new shares of the Berlin Company as they may be entitled to in respect of their holdings in this company." Count Oscar Reichenback (a director) seconded the motion. In reply to Mr. Dunphy, the chairman stated that the object of the new cable was to give Germany direct telegraphic communication to America, instead of the messages coming to London first. The new cable would have to be laid by the German Union Company, or by some one else. It would have one wire, and be used exclusively for American traffic. There were four wires in the present cable, which, of course, would be maintained. In answer to Mr. Pender, M.P., the chairman added that the new capital would be a first charge on the whole revenue of the company. The resolution was unanimously passed.

GLOBE TELEGRAPH AND TRUST.—The report for the year ending July 18th states that the net revenue, after deduction of expenses, amounts to £171,379, which, with the balance of £841 brought forward, makes a total of £172,221. From this amount there has been distributed in interim dividends the sum of £122,066, and the directors have written a further sum of £500 off the preliminary expenses account, leaving an available balance of £49,655. The directors now recommend payment of a final dividend for the year of 3s. per share on the preference shares, and of 3s. per share on the ordinary shares (making, with the former distributions, a total dividend for the year of 6 per cent. upon the preference and 4½ per cent. upon the ordinary shares), carrying forward a balance of £665. The directors have issued 527 preference shares and 525 ordinary shares in exchange for 1,000 Eastern Telegraph ordinary shares; and an exchange has been made of 1,000 Telegraph Construction and Maintenance shares for 3,000 Eastern Telegraph ordinary shares. Eleven shares of the German Norwegian Cable Company have been drawn and paid off at par. In conformity with the articles of association, Mr. William Ford and Sir Daniel Gooch, Bart., M.P., two of the directors, retire, but being eligible, they offer themselves for re-election. The auditors, William Newmarch, Esq., F.R.S., and John George Griffiths, Esq., F.C.A. (Messrs. Deloitte, Dever, Griffiths, and Co.), also retire at the meeting. Mr. Griffiths offers himself for re-election, but Mr. Newmarch, much to the regret of the board, does not. A statement appended to the report shows the stocks, shares, and debentures held by the company, and the income therefrom. The total nominal amount of these holdings is £3,367,738, the cost by exchange or sale and purchase £3,260,367, and the amount of dividend received during the year £174,766.

ELECTRIC LIGHT AND POWER GENERATOR COMPANY.—An extraordinary general meeting of the shareholders of this company was held at the company's offices and works, 29, Bankside, on Wednesday, July 20th, 1881, to confirm a special resolution, passed at a meeting of members on July 5th, for making certain alterations in the articles of association. Admiral Sir Edward Inglefield, C.B., occupied the chair. The secretary read the notice convening the meeting and setting out the proposed alterations in the articles. The chairman said: Gentlemen, I have to put this special resolution before you and to propose that you agree to it. The resolution was carried, and several questions having been addressed to the chairman, that gentleman said he would reply to them

ategorically: First with regard to the district allotted › the company for lighting. It was called No. 2, and omprised Southwark Bridge, Queen Street Place, and ueen Victoria Street. They had the advantage of aving several distinct cables, in case one portion hould not be as successful as the other; in fact they ad four distinct cables, so that, for instance, if they hould find that evening that one portion did not work ell they could still go on working with the other three ithout the fourth. Accidents might happen, a cab inning against one of the lamp posts would break the ontact for a time, but by having three other cables to ork with there need be no apprehension on the part of ither the shareholders, however anxious they might el, or of the public, that there could be any serious reakdown even should any unforeseen accident occur. he shareholders probably knew the district quite well, nd he need not, therefore, give particulars as to the ngth of cable and so on required, but he believed it as about four miles. He would, however, like to xplain the precautions which had been taken to insure e success of their experiment that evening. In the rst place the cable was of course laid and was intact, nd all the lamps were in order in the works ready to e hung, and he would be happy to exhibit them to the areholders when the meeting was over. They had, fact, had every one of the lamps hanging side by de in the works, so that the ability of each lamp to oroughly do its work had been fully tested. In every spect they had taken every care to insure success as r as possible that evening, and there could be no oubt that their success was a certainty. In answer to question by a shareholder, Mr. Crookes said that rough a good cable 75 per cent. of the power could e carried to a very distant part. The meeting having rminated, the shareholders proceeded to inspect the reparations going on in the works.

Western and Brazilian Telegraph.—The eighth dinary annual general meeting of this company was eld at the Cannon Street Hotel on Wednesday, 20th st., Sir Henry Drummond Wolff in the chair. The cretary read the notice convening the meeting, as so the minutes of the last annual meeting, which were onfirmed, and the report and accounts were taken as ad. The chairman: It now becomes my duty, gentle-en, which I rise to fulfil with some diffidence owing to y recent connection with this company, to make a few marks upon the report which was issued and circulated nong you some time ago, and to give the reasons why e directors postponed the ordinary annual general eeting until this time. You will, no doubt, be gratified know that the traffic of the company has been in-easing, slowly it is true, but with a regular progression. t the present moment, by the most recent traffic returns r a period of forty-one weeks, we can show a balance receipts over expenses as compared with the same eriod in last year of £4,854. (Hear, hear.) In fact, e receipts are gradually mounting up, and, unless an cident of a serious nature occurs between now and ext October, would warrant the directors in declaring me dividend, provided we had a substantial reserve nd to justify us in dividing amongst the shareholders e profits made. (Hear, hear.) I will not dwell very uch upon the general features of the report itself, inas-uch as when the report was issued you were informed at any additional information which was desired could e obtained at the offices of the company. Up to this me, however, there have been but very few applications r information or explanation at the office; therefore, there were any questions that the shareholders wished have answered we may fairly conclude that they ould have been asked. But I shall be happy now to give any information you wish for with regard to any of the details of the report. I am now coming to deal with that which I consider, and which you will no doubt also consider, the most important object of the meeting held this day, which is, that the meeting should either confirm or reject the offer of compromise which has been made to us with regard to a suit now pending in the Court of Chancery. The directors might rightly under their powers have accepted this compromise without reference to the shareholders. We consider, however, that, although the statute confers upon us the power, yet as the claims which are the subject of litigation in that suit rather concerned the inception of the company than its actual progress since it was formed, and as the subject was of such grave importance to the company, we deemed it our duty to submit the compromise to your judgment and approval. (Hear, hear.) I must say, however, that the directors, though not doubting in any way the strength of their case, have, under the advice of the same eminent counsel as have advised them all through the proceedings, determined to recommend the acceptance by the shareholders of the offers made to us. Our reason for that is simply this: we see and recognise the great necessity for establishing a good and substantial reserve fund, and we think that by accepting this proposal we shall be enabled at once to carry out that important object. (Hear, hear.) Therefore I beg to propose the adoption of the report, which will be seconded by one of my colleagues, and after that I shall be happy to answer any questions you may wish to put. Then, after that, we propose, with the consent of the meeting, to move a further resolution, which will embody the substance of the supplemental report which has also been issued, and accompanied the report itself. I beg to propose the adoption of the report. Mr. Andrews: I have great pleasure in seconding that resolution. The chairman: Is it your pleasure that the report, accounts, and balance-sheet up to September 30th, 1880, be approved and adopted? Carried unanimously. The chairman: I will now propose the next resolution—"That the company, in general meeting assembled, hereby approves of the directors compromising the actions referred to in the reports submitted to this meeting, on the basis stated in general terms in the supplemental report dated the 12th July, 1881, with such modifications or alterations and provisions not affecting the net results to the company as the directors may deem expedient and the nature of the arrangement may require." Mr. Goodsall: I beg to second it. The motion confirming the acceptance of a compromise was then put to the meeting and carried unanimously. Sir H. Drummond Wolff and Mr. D. H. Goodsall having been re-elected as directors, and Mr. Weise re-elected as auditor, the meeting closed after warm expressions of confidence in the chairman and his colleagues.

India Rubber, Gutta Percha and Telegraph Works Company, Limited.—At the half-yearly general meeting of this company held on the 21st July, Mr. George Henderson in the chair, the secretary (Mr. William J. Tyler) having read the notice convening the meeting, the chairman said: Gentlemen, this is merely a formal meeting to obtain your sanction to an interim dividend, and we are very pleased at having it in our power to pay this dividend from fairly earned money. The general business of the company is going on in a very satisfactory manner, but orders for cables have been slack during the half-year. I have really nothing more to say to-day, and therefore I will move the resolution that an interim dividend of 10s. per share, free of income-tax, being at the rate of 10 per cent. per

annum, payable on and after the 22nd inst., be now declared. Mr. S. W. Silver seconded the motion, which was carried unanimously. After a vote of thanks to the chairman the proceedings terminated.

CUBA SUBMARINE TELEGRAPH COMPANY.—At the meeting on July 20th, the report (*see* TELEGRAPHIC JOURNAL, July 15th) and accounts were adopted after a few remarks by the chairman, Mr. T. Hughes, Q.C., and some of the shareholders.

TELEGRAPH CONSTRUCTION AND MAINTENANCE COMPANY, LIMITED.—A half-yearly general meeting of this company was held on July 19th at the offices, 38, Old Broad Street, under the presidency of Sir D. Gooch, Bart., M.P. The chairman (who had no resolution to propose) stated that during the past half-year they had not had very much in hand. They had made only 200 miles of cable, but they had chartered one of their ships to the Government for the conveyance of troops to the Cape, and another for some cable work. The *Scotia* had recently returned from repairing the Brest cable, which was now in efficient working order. Last year the enterprise failed on account of the extremely bad weather, and the vessel returned home, leaving the work uncompleted. This year, however, she had succeeded, having raised the cable from 1,700 fathoms of water, and a new piece of cable was put in. They were doing the best they could to obtain work, and they must hope that something would occur by which they would receive employment. Mr. W. Abbott asked, in view of the development of electricity, whether the company could not ally itself with some of the companies concerned in inventions arising out of the science of electricity, so as to fill up the void when cable work was slack? He thought that they should identify themselves with other work besides cable manufacturing. The chairman, in reply, said that they had not overlooked the matter, and that they were now making a large amount of covering wire required for the electric light, which, there could be no doubt, was only just beginning to be used. In answer to another question, the chairman said that the dividend would be the usual interim distribution of 12s. The meeting closed with the usual complimentary vote.

TELEGRAPHING TO INDIA, AUSTRALIA AND CHINA.—The following communication from the Indo-European Telegraph Company, Limited, has been addressed to the daily press:—"Both the cables of the Eastern Telegraph Company between Aden and Bombay are broken down on the Bombay coast, and cannot at present, in spite of every effort, be got at for repairs owing to the monsoon being in full activity. Of the cables belonging to the Indo-European Government Department in the Persian Gulf, and forming part of the Indo-European Telegraph *via* Teheran, one of the two cables between Bushire and Jask is interrupted, and the cable off the Beloochistan coast is also broken down. This reduces the communication between Bushire and Kurrachee, and consequently that between Europe and India, to only one wire, instead of the four wires and two duplicated routes which are usually at the disposal of the public. In reference to the notice from the Turkish Ambassador that messages may be transmitted by way of Bagdad and Bushire, such a course would be very inadvisable, because the present special direct wires of the Indo-European Telegraph Company to Teheran and thence to Bushire are working without any delay whatever, the delay lying between Bushire and Kurrachee. At the time of writing, however (noon of Monday), the delay from India has been reduced to two hours fourteen minutes, and telegrams from China and Australia are arriving in from four to five hours. The Indo-European Government Department have ordered their cable-repairing ship, *Patrick Stewart*, to proceed at once to Bushire to set right the Bushire-Jask section, and the repair of this section will greatly improve the working. As soon as this object is accomplished she will be ordered to repair the cable along the Beloochistan coast, thus restoring the duplicate wires of the Indo-European route *via* Teheran, when all delay will cease, as either of the duplicated lines of the Indo-European or of the Eastern route is easily capable of doing all the work when they are in their usual order."

AN Ottawa telegram states that the Canadian, European, American, and Asiatic Company, to which a charter was granted in the last Dominion Parliament, has completed its organisation. The Canadian end of this cable will land on Sable Island. Telegraphic communication will also be established with the West Indies.—*Liverpool Journal of Commerce.*

IN view of the competition expected from the American Cable Company, the Anglo-American, with the Direct U. S., and the Compagnie Francaise, advertise a reduction in tariff on and after August 1st to New York to 1s. per word, the name of the place from which the message originates being transmitted free of charge.

The following are the final quotations of stocks and shares for the 27th ult.:—Anglo-American, Limited, 51¾-52¼; Ditto, Preferred, 82½-83½; Ditto, Deferred, 25-25½; Brazilian Submarine, Limited, 10⅜-10⅝; Brush Light, ——; Electric Light, ⅜-⅝; Consolidated Telephone Construction, ⅝-¾ A; Cuba, Limited, 9¾-10¼; Cuba, Limited, 10 per cent. Preference, 16¾-17¼; Direct Spanish, Limited, 4¾-5¼; Direct Spanish, 10 per cent. Preference, 13½-14½; Direct United States Cable, Limited, 1877, 10⅜-10⅞; Debentures, 1884, 102-104; Eastern Limited, 10¼-10½; Eastern 6 per cent. Preference, 12⅞-13⅜; Eastern, 6 per cent. Debentures, repayable October, 1883, 103-106; Eastern 5 per cent. Debentures, repayable August, 1887, 104-107; Eastern, 5 per cent., repayable Aug., 1899, 106-109; Eastern Extension, Australasian and China, Limited, 11-11½; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 109-112; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 103-106; Ditto, registered, repayable 1900, 103-106; Ditto, 5 per cent. Debenture, 1890, 103-105; Eastern and South African, Limited, 5 per cent. Mortgage Debentures, redeemable 1900, 104-107; Ditto, ditto, to bearer, 104-107; German Union Telegraph and Trust, 9½-10½; Globe Telegraph and Trust, Limited, 6½-6¾; Globe, 6 per cent. Preference, 12½-12¾; Great Northern, 12¾-13¼; 5 per cent. Debentures, 102-105; India Rubber Company, 20½-21½; Ditto, 6 per cent. Debenture, 104-108; Indo-European, Limited, 28-29; London Platino-Brazilian, Limited, 5⅝-6⅛; Mediterranean Extension, Limited, 2¾-3¼; Mediterranean Extension, 8 per cent. Preference, 9-9½; Oriental Telephone, ¼ dis. par.; Reuter's Limited, 12-13; Submarine, 285-295; Submarine Scrip, 2¾-3; Submarine Cables Trust, 100-104; United Telephone, 9¼; West Coast of America, Limited, 4½-5; West India and Panama, Limited, 1⅞-2⅛; Ditto, 6 per cent. First Preference, 7-7½; Ditto, ditto, Second Preference, 6-6½; Western and Brazilian, Limited, 8¼-8¾; Ditto, 6 per cent. Debentures "A," 110-115; Ditto, ditto, ditto, "B," 101-105; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 125-130; Ditto, 6 per cent. Sterling Bonds, 106-110; Telegraph Construction and Maintenance, Limited, 31¼-31¾; Ditto, 6 per cent. Bonds, 103-107; Ditto, Second Bonus Trust Certificates, 3¾-4¼.

HE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. IX.—No. 205.

THE PARIS ELECTRICAL EXHIBITION.

N Wednesday, the 10th inst., the opening of the aris Electrical Exhibition was practically inaugu .ted by the visit of M. Grévy, the President of ie French Republic. Although the Exhibition as by no means ready, wonderful progress had en made towards getting matters into a pre- :ntable shape during the early morning of the ıy of the President's visit, so that a very fair and :derly array of apparatus was to be seen in the ırious sections of the building. In many cases, is true, almost bare tables were all that were esented to view, and in this respect the British epartment was not the least conspicuous, although ie very select display of exhibits made by many anufacturers went far to hide this defect.

Immediately on entering the building, amidst e martial strains of a fine military band, the esident proceeded through the various sections the British Department, being conducted through e latter under the leadership of Lord Crawford d Balcarres the Chief British Commissioner; the ıstrian, German, and other Departments, were xt inspected, and the President then left the ilding, having examined the principal objects to ıich his attention had been drawn. In the British epartment the most conspicuous stand is un- ubtedly that of the Postal Telegraph Depart- :nt, and here a large collection of ancient l modern apparatus is shown. The earliest ırkable telegraph exhibited (which has been lent Mr. Latimer Clark) is that of Ronald's, which tes from 1816. Although not a practical appa- :us, it had the great merit of being more than :rely theoretical, as messages were actually and :cessfully transmitted by its means, and as a entific curiosity it is certainly one of the most eresting exhibits in the collection. From 1816 to 17 is a considerable gap, but from the latter year electric telegraph in England as a successful erprise practically dates. In 1837 the first under- ıund telegraph was laid between Euston and nden, the wires being insulated by being ıedded in scantlings of oak; the instrument rked through this line of wires had five dles, and was known as the "Hatchment" :graph. In 1838 the five needles were reduced four, and in 1842 the number was still :her diminished to two. This latter instrument for many years did excellent work and was largely used, and although it has now for some years been suspended, it is still remembered with affection by many clerks who used to work it, as its powers of getting off messages were very considerable—more, indeed, than might be imagined. A remarkable specimen of the instrument in an enormous Gothic case is amongst the exhibits. This instrument was made for use in the Houses of Parliament, and its case was, it is said, designed specially to harmonise with the architecture of the Westminster buildings. A double-needle instrument, dated 1852, and designed by Messrs. Edwin and Latimer Clark, is one of the earliest forms of a thoroughly practical train-signalling instrument, indeed, its principle is still largely used at the present day. The single needle-apparatus, which dates from 1846, is still very largely employed in England, and its form remains, generally speaking, as it was originally. The pattern at present employed by the Post Office dates from 1869. In the Bain-needle instrument, devised in 1843, the signals are produced by the movements of two distinct needles, the one moving to the right and the other to the left. The gold-leaf apparatus of Highton, although not adapted for rough work, was used to some slight extent, and it was proposed a few years ago to employ it for working on submarine cables, but the project was never successfully floated. Compared with the easy working apparatus of the present day, the magneto-electric needle instrument of Henley, dated 1848, is a very heavy-looking piece of work, yet its general design is by no means bad for the date at which it was employed, and in the hands of efficient clerks it did good service, although its manipulation must have been extremely fatiguing. The alphabetical telegraph apparatus of Wheatstone, of the present day and of the year 1840, are certainly remarkable contrasts, the latter being as clumsy a piece of telegraph machinery as can well be conceived, the former a perfect specimen of mechanical skill and design, yet one which seems doomed to be superseded by its simpler rival the telephone.

The relics of a bygone age, in the shape of transmitting keys, relays, &c., are interesting to those who wish to know the progress that has been made both in electrical and mechanical skill since the telegraph became a practical reality. Specimens of wire joints, old railway signalling apparatus (the latter peculiarly interesting, as it shows that the use of the telegraph to train signalling was as early as its use for message transmission), old lightning protectors, old insulators, and a specimen of the first cable laid across the Channel, completes the list.

In modern apparatus, Great Britain is certainly not behind the other nations, and although the whole of the instruments and material in use at the present day are not represented, yet a very good show is made. In fast-speed apparatus Great Britain is undoubtedly well ahead of other countries. The fast repeater and fast duplex repeater-boards are fine specimens of workmanship, design, and arrangement, and indicate well the perfection to which this kind of apparatus may be brought; many of the boards are in daily use in the Postal Telegraph Service, and enable long circuits in our

peculiar climate to be worked throughout at their utmost speed. A very great deal of the success obtained in high-speed working is due to the form of relay used, and great credit is due to the designers of the form at present employed in the Post Office. An Umschalter switch for intercommunication between various lines, constructed in the postal workshops, is a fine specimen of good workmanship. The other apparatus exhibited are as follows: double current sounder set; testing tangent galvanometer, with standard cell; numbering machine for stamping messages; modern form of train-signalling apparatus (Preece's); apparatus connected with pneumatic tubes, together with specimens of the letter-carriers, &c.; and an electrical water level indicator.

Next to attract observation after the Post Office apparatus is the display of Messrs. Siemens Bros. & Co. (of England), who show a pyramid of coiled cable on which is mounted a submarine telegraph buoy; the latter is crowned by a beacon, the whole forming a most appropriate centre-piece to the remaining portion of the smaller exhibits. This firm displays, in addition to the foregoing, a large number of dynamo machines and lamps, an electrical railway, &c., whilst surrounding the space allotted to the above-mentioned buoy will be found electric conductors, electrical instruments, and apparatus of various kinds.

We must not omit to mention one noteworthy exhibit which occupies the centre of the nave, and which consists of a tower supporting a lighthouse, and surrounded by an ornamental piece of water on which floats an electrically propelled boat, named the *Telephone*. The lighthouse is to be illuminated by the De Meriten's system. There will also be much interest attaching to the Tissandier balloon, propelled by a dynamo-electric machine. An experiment with this aerial machine was made during M. Grévy's visit.

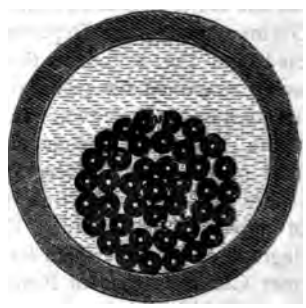
The exhibit of Messrs. Elliott Brothers, near to that of the British Postal Telegraph Department, is very extensive, and includes specimens of most of those instruments for testing and measuring for which this firm is so justly celebrated. To this exhibit we shall again refer. The India-Rubber and Gutta-Percha Company show a collection of specimen cables, &c., and a sample length of the Brooks' underground cable. The Telegraph Construction and Maintenance Company have a fine collection of submarine cables of types already in operation. We must, however, pause for the present in our course, but in conclusion would refer to what will probably prove to be the most important display of electric lights ever seen, and which will certainly be one of the most attractive displays in the whole exhibition. There may be seen the Brush, the Siemens, the Brockie, the Pilsen, and other arc lamps, the Joel-Werdermann, the Swan, the Edison, the Lane-Fox, and other incandescence systems, besides almost innumerable dynamo-machines to be used in generating power for illuminating the same.

To drive the generators, steam-engines by some of our most noted English firms, such as Messrs. P. Brotherhood, Robey & Co., Marshall & Co., Ransomes & Co., and Wallis & Stevens, will be largely employed.

BROOKS' UNDERGROUND TELEGRAPH SYSTEM.

LAST year Mr. David Brooks, of Philadelphia, made a proposition to the Postal Telegraph authorities that he should lay an experimental length of his underground telegraph system (*see* TELEGRAPHIC JOURNAL, Dec. 1, 1879) between Waterloo and Nine Elms on the London and South-Western Railway. The length laid was to be paid for on condition that it worked satisfactorily for a period of six months. Mr. Brooks also proposed to extend the system from Nine Elms to Clapham during the following year (1881) upon the same terms as those first proposed if the postal authorities thought fit to accept them. In the spring of the present year Mr. Brooks returned to England to carry out his second proposition, as the Post Office had accepted his offer, the preliminary experiment having proved quite satisfactory. The extension of the line from Nine Elms to Clapham has now been completed, and premises to prove as great a success as has the trial line.

The line completed last year consisted of 30 No. 18 copper conductors, each insulated with a jute serving, and then spun into a cable and drawn into a 1¼-inch iron pipe, the latter, as explained in the number of the JOURNAL before referred to, being filled with paraffin oil; the total length of this line was 7,000 feet. The extended line from Nine Elms up to Queen's Road, a distance of 5,800 feet, also consists of 30 wires similar in every respect to those first laid down. From Queen's Road to Clapham, a distance of 7,000 feet, the cable is



formed of 40 wires of a similar gauge, as regards the conductor, to those in the first-mentioned lengths, but with a slightly thinner jute serving, so that the whole 40 could be inclosed in a 1¼-inch pipe. In both cases the total outside diameter of the cable was about one inch.

Owing to a difficulty in making a proper termination to the cable at Waterloo, the ends of the wires were unavoidably exposed, to a considerable extent, to the weather, and consequently reliable tests could not be taken, more especially as it was necessary to employ a lead wire of 500 yards, insufficiently protected, to make the tests with. Sufficient knowledge of the condition of the cable was, however, obtained to justify its being considered in thorough working condition, and time has proved that this conclusion was completely correct.

During the present season the work of extending ɔ system was commenced and carried on from ɜ Clapham station, where better opportunities ɹre afforded of making tests than could be obtained Waterloo. The following are the results obtained ɒm Nos. 1 to 10 inclusive of the 40-wire length tween Clapham and Queen's Road, a distance of ɒoo feet:—

No. of Wire.	Insulation Resistance per Mile in Megohms.	Electrostatic Capacity per Mile in Microfarads.
1	3·06	·487
2	2·83	·475
3	2·71	·464
4	2·52	·475
5	2·75	·475
6	2·81	·487
7	2·95	·453
8	2·90	·475
9	3·00	·487
10	Not tested, being in use for working purposes.	

The remaining 30 wires of the 40-wire cable rhich, as explained, only extended to Queen's oad) were joined to the 30-wire cable, which ached to Nine Elms, a total distance of 12,800 et, and the tests taken gave the following figures:—

No. of Wire.	Insulation Resistance per Mile in Megohms.	Electrostatic Capacity per Mile in Microfarads
1	2·13	·446
2	2·09	·451
3	1·78	·451
4	2·06	·451
5	2·13	·446
6	2·20	·446
7	2·13	·451
8	2·06	·446
9	1·50	·451
10	2·00	·446
11	2·13	·451
12	2·06	·439
13	2·13	·451
14	2·20	·446
15	2·13	·446
16	2·13	·446
17	2·13	·458
18	2·13	·451
19	2·20	·451
20	2·06	·451
21	2·06	·433
22	2·00	·446
23	2·20	·458
24	2·13	·446
25	2·13	·427
26	2·27	·427
27	2·20	·451
28	2·13	·451
29	2·06	·446
30	2·13	·451

Two days after the foregoing tests were taken, ı old 30-wire length between Nine Elms and ;pham was joined on to the new cable at Nine ns, thus making a cable of 30 wires between pham and Waterloo, of a length of 19,800 yards, about 3¾ miles. A fresh test made of wires Nos. 1 to 10 inclusive, from Clapham to Queen's Road, gave the following results:—

No. of Wire.	Insulation Resistance per Mile in Megohms
1	2·33
2	2·78
3	2·66
4	2·50
5	2·93
6	2·96
7	3·06
8	3·10
9	2·80
10	Not tested, being in use for working purposes.

A test of wires Nos. 11 to 40 inclusive, from Clapham to Waterloo, showed the following:—

No. of Wire.	Insulation Resistance per Mile in Megohms.	Electrostatic Capacity per Mile in Microfarads.
11	3·91	·317
12	3·97	·310
13	3·20	·310
14	3·97	·314
15	3·70	·317
16	3·45	·314
17	3·91	·317
18	4·08	·310
19	3·89	·299
20	4·02	
21	3·02	
22	3·02	
23	3·58	
24	3·58	
25	3·70	
26	3·83	
27	3·89	
28	3·93	
29	3·72	
30	3·65	
31	3·85	
32	4·05	
33	3·70	
34	4·02	
35	4·72	
36	4·10	
37	3·72	
38	3·95	
39	3·97	
40	4·12	

All the results given are those obtained at the normal temperature; the latter it was difficult to ascertain, as a portion of the pipe was exposed to the full action of the rays of the sun, and being blackened, would be a great number of degrees above the other portion, which was buried. Up to the present, no satisfactory co-efficient for indicating the alteration in resistance by change of temperature in the Brooks' cable has been obtained; it differs with every quality of oil, and also with the nature of the serving laid on the wires. The higher quality oils have a higher co-efficient of change than those of a lower grade, and in this respect the oil resembles gutta-percha. Mr. Brooks states that the co-efficient for oil and jute combined is but one-half that for the oil alone.

The figure represents a sectional view of the 40-

wire cable, and from it we can see at a glance that if we test any particular wire with all the other wires connected to earth, then the insulation resistance will be directly dependent upon the distance that the conductor of each wire is from the others, whilst the electrostatic capacity will vary inversely as this distance, hence the wires with the thicker coverings will have a higher insulation resistance and a lower electrostatic capacity than those with the thinner coverings; this is found to be the case, other things being similar.

The insulation resistance per mile of the cables, it may be remarked, is lower than that specified for and guaranteed by Mr. Brooks; but this is due to the fact that the paraffin oil with which the pipes are filled is of very common quality, obtained in England, and run in as a preliminary to the introduction of oil of a specially prepared quality. This latter oil has been supplied by Mr. Brooks, and is ready to be used should it be considered necessary at any time to increase the insulation above the present figures. As compared with the following tests of the Antwerp cable (*see* TELEGRAPHIC JOURNAL, April 5th, 1881)

No. of Wire.	Insulation Resistance per Kilom.* in Megohms.	Electrostatic Capacity per Kilom.* in Microfds.
1	211	0·095
2	164	0·140
3	185	0·125
4	152	0·133
5	179	0·138
6	173	0·146
7	133	0·135
8	164	0·135
9	158	0·143
10	146	0·130
11	164	0·130
12	133	0·140
13	133	1·135
14	164	0·133
15	133	0·125
16	164	0·140
17	133	0·135
18	185	0·130

the results may appear to be very unsatisfactory, but such is by no means the case. There is undoubtedly a very general impression abroad that high insulation is, above everything, the indication of a sound and good working line; there cannot be a greater mistake than to suppose this. In certain cases, in gutta-percha for example, excessively high insulation is an indication of a poor quality of material, a quality, in fact, which is not durable; a great deal depends upon the age of the manufactured material, it is true, but if we take two insulated wires of similar age, and in one we find a moderate insulation which will resist a high battery power for a lengthened period, and in the other we find an extremely high insulation, then we may be sure that the latter is due to a poor quality material, and that its chances of durability are comparatively small. This is not all, however, for even supposing that high insulation can be obtained consistent with durability, there is nothing whatever gained by a high result as regards its working value, in fact it is a positive advantage to have *low* insulation, provided the latter is due to the *nature* of the insulating material, and not to a *defect* in it. It is a well-known fact that speed of working on underground lines is under certain conditions increased by a defect in the insulation. Several years ago in Germany this fact was noted by Kramer, who states that he often left his bureau to put a fault on the line in order to be able to forward a despatch with greater ease (*see* Sabine's "The Electric Telegraph"). The reason of this is that a low insulation enables the static charge in a line to dissipate itself with considerable rapidity instead of slowly discharging itself at the ends of the line only, and running the signals together. But it is very necessary for thorough good working that the low insulation should not be due to a *defect;* the latter *may* improve the working, but it is much more likely to spoil it by continual variation, hence the problem to be solved in underground lines is *low* insulation (within certain limits, of course, for there must be sufficient insulation to enable a good proportion of the transmitted current to be received at the receiving end of the line) consistent with durability, and this Mr. Brooks has obtained in his new system.

Experiment shows that the Brooks' system may be employed with great advantage for telephone working; a *single* wire of the cable between Waterloo and Nine Elms has been employed as a telephone circuit for some time, and, although the other 29 wires are heavily worked, yet the inductive interference has not been such as to cause inconvenience. A telephone placed on two wires of the entire length between Waterloo and Clapham did not emit any sound, although a Wheatstone automatic instrument with high battery power was being worked on one of the other wires; the metallic loop, it may be observed, was not a twisted one, but was formed of two wires picked at random from the group of thirty. No doubt the satisfactory result obtained is in a great measure due to the fact that the relative positions of the various circuits in the pipe is different at every point throughout the length. In cases where a number of wires in a cable are employed for telephone working alone it is found that the inductive interference between wire and wire diminishes in proportion to the number of wires in the pipe, a result due, no doubt to the distribution of the effect.

The length of cable between Waterloo and Nine Elms, which has been working for several months, has not been provided with lightning protectors, although it is the general rule in the Postal Telegraph Department that all underground work shall be so fitted. No interruption has, however, been caused by lightning, although several storms have been experienced since the cable commenced working. From experiments made by Mr. Brooks it appears that if an earth fault is caused in the cable by a lightning discharge a circulation given to the oil will cause the fault to disappear; this is due, no doubt, to the carbonised matter which causes the fault and which is the result of the electric discharge, being washed away as it were, by the flow of oil; this flow, as a matter of fact, being considerably assisted by the continual changes of temperature which take place. It must be evident that the foregoing is an important point in favour of the Brooks' system, as faults in ordinary gutta-percha underground work are very troublesome to

* *A kilomètre is about five-eighths of a mile.*

·; the damaged wire, in fact, must be taken the pipe.

length of cable between Nine Elms and m was laid down by the India-Rubber, Gutta- and Telegraph Works Company, of Silver- ınder the direction of Mr. Brooks, and we and that an arrangement has been made by future works of the kind will be contracted executed by the same company.

HE REFRACTION OF ELECTRICITY.

ED TRIBE, Lecturer on Chemistry in Dulwich College.

(*Continued from page* 291.)

›sitions of the relatively good and bad con- media were now reversed. The 1 per cent. was placed in the transmitting cell, and the rated in the refracting cell. An analyser at *i* d a non-parallel distribution, and the curvature ition of the ions showed that the course of gy had been bent about 15°. But in this case ction was *from* a perpendicular to the refract- ice.

now natural to anticipate that the refraction, iven incidence, would decrease or increase as ia in the refracting and transmitting cells ap- l or receded in conducting power. This was o be the case, first, by replacing the 1 per cent. of copper sulphate in the refracting cell by a and 10 per cent. solution respectively, when s at *i* recorded respectively a decreasing re- as the media in the cells approached equality. condly, by placing a 5 per cent. solution of ulphate in the refracting cell, and successively trated solution of copper sulphate, a concen- lution of sodium chloride, and a dilute solution of oil of vitriol in the transmitting cell. s at *i* showed, in the case of the copper sul- refraction of about 15°, in the case of the chloride, 30°, and in that of the dilute sul- id, 40°. The order of the increase in refrac- re the same as that of the conductivities of ls.

it was anticipated that the refraction would as the incidence decreased. This was proved e by setting the diaphragms so that the angle ence should be 45°, 30°, and 15° respec- With a 5 per cent. solution of copper sulphate fracting cell, and dilute sulphuric acid in the ing cell, a refraction of about 35° was obtained incidence was 45°, about 22° when at 30°, it 7° when at 15°.

ı between Electric Incidence and Refraction.

art of the electro-chemical method which has ady described supplies three means of deter- he bending of the course of the energy on its nto the refracting cell. First, by the curvature ons on an analyser with the shorter edges of upright, and its length perpendicular to the s. But the practical impossibility of obtaining measurements of these curves renders this roughly quantitative. Secondly, by placing ser at various angles to a right line joining rodes, until it records a *parallel* distribution. the case when the course of the energy is vith the sides of the analysing plate, and the angle inclosed between the plate and the right line referred to consequently expresses the amount of refraction. The objections to this plan are twofold. It is very tedious, and it is also difficult to determine with sufficient accuracy the angle of the plate as it stands in the cell. The refraction numbers given above were obtained by this second method, and for the last of the reasons just mentioned I regard them only as approximately correct. The third plan, based on the fact that the course of the influence, when parallel to the sides of an analyser, is perpendicular to the boundary lines of the ions set free (as described in 7) is the one I have employed for the more accurate determination of the relation between electric incidence and refraction.

I employed for this purpose four similar electrolytic cells of the shape and dimensions previously given. Pairs of porous plates were set across each of these cells, as before described, so as to give in one case an incident angle of 45°; in the second, 37½°; in the third, 30°; and in the fourth, 15°. Dilute sulphuric acid (1 to 11) was used in the transmitting cell, and a 5 per cent. solution of copper sulphate in the refracting cell. The current generally used was three Webers, though variations in this respect were found not to affect the refraction. The time of each determination was five minutes. The analysers employed were squares (24 millims. the side) of sheet silver, and discs of the same material 24 millims. in diameter. These were immersed horizontally in the centre of the refracting cell, the squares in such a way that their edges were parallel with the respective sides and ends of the rectangular electrolytic cell; the discs, so that a line passing through their centres was coincident with a line joining the electrodes.

As it has been already shown that the course of the energy in the transmitting and refracting cells was in the same horizontal plane, it was to be anticipated that the boundary lines of the ions on the analysers placed in the positions just described would be straight. Such is the case with the boundary of the negative ion, which consequently is taken for purposes of measurement.

Were the course of the energy in the inner cell identical with that in the transmitting cell, the boundary lines, in accordance with the rule in β, would be perpendicular to a right line joining the electrodes, and this might be named the zero line, or line of no refraction. And were the analysers in the position described, the zero line would be perpendicular to the central line on the discs and to the edges of the squares, which are parallel with the sides of the cell. It follows that, were the course of the energy diverted from the right line joining the electrodes (its original course) the boundary line of the ion would deviate *pari passu* from the line of no refraction. The numbers expressing this obliquity or amount of refraction in five series of trials are given in the annexed table. In Series I. II. III. square analysers were used, and for IV. and V. the discs already described.

Angle of Incidence.	Deviation.				
	I.	II.	III.	IV.	
°	°	°	°	°	°
15	9	9	9	10	9
30	19	20	19	19	20
37½	27	26	25	26	25
45	31	31	33	33	32

These *data* give the following ratios between the angles of incidence and refraction—

$$\frac{i}{r}.$$

.	II.	III.	IV.	V.
2·5	2·5	2·5	3·0	2·5
2·7	3·0	2·7	2·7	3·0
3·5	3·3	3·0	3·3	3·0
3·2	3·2	3·7	3·7	3·4

and the following ratios between the sines of the angles of incidence and refraction—

$$\frac{\sin i}{\sin r}.$$

I.	II.	III.	IV.	V.
2·5	2·5	2·5	2·9	2·5
2·6	2·8	2·6	2·6	2·8
3·3	3·0	2·3	3·0	2·8
2·9	2·9	3·4	3·4	3·1

Taking the results as they thus appear, I think they justify the conclusion that the more probable relation between electrical incidence and refraction is as the sines of their respective angles. And further, as the experimental difficulties are overcome and the inherent sources of error appreciated, this relation may be still more rigidly found to obtain.

This electro-chemical method being new, it would be well to supplement, if possible, the evidence it has furnished of the laws of electric refraction by one based on more familiar principles. I am engaged in perfecting a method founded on those employed by De la Rive in 1825, and by Professor Adams in 1875, for investigating the laws of electric distribution in electrolytes, which I believe will demonstrate in another way the main facts set forth in this communication.

Conclusions.

I. Electricity passes without alteration of direction from one electrolytic medium to another differing from it in conductivity, when the course is perpendicular to the surfaces of contact.

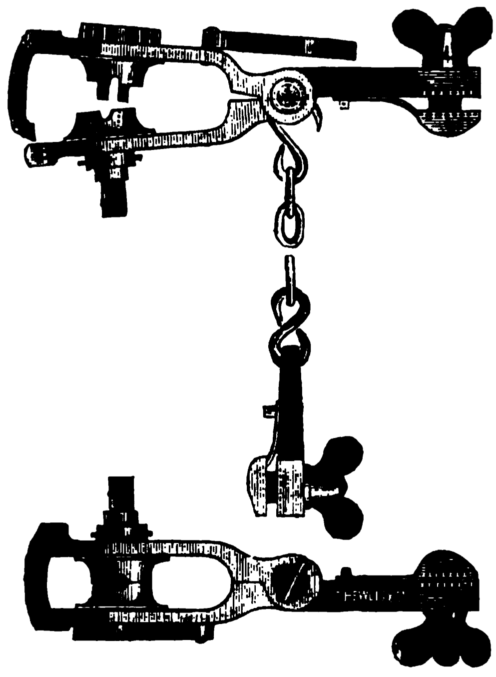
II. Electricity, on passing obliquely from one medium to the other, suffers refraction, and in the same plane; towards the perpendicular, when from a better to a worse conductor, and from the perpendicular when from a worse to a better conductor.

III. The refraction increases or decreases as the media recede from or approach one another in conductivity.

IV. The refraction increases as the incidence increases.

FLETCHER'S PATENT DRAW VICE.

THE peculiarity of this new form of draw-vice consists in the fact that it enables linemen to strain up telegraph wires, when constructing or repairing a line, without the use of a second draw vice or any of the usual means for securing the wires which have hitherto been employed. The new draw-vice, which is shown by the figures, is provided with a split drum on which the slack is wound and which can be emptied as often as required, so that any amount of sag can be pulled up. When the drum is full, the wire is secured by the small vice and chain, and the catch knocked off with a key,



when the surplus wire can be removed from the drum and cut off; this being done a fresh hold is taken and the drum again filled and emptied until all the slack wire has been drawn in and proper regulation obtained. Messrs. Thewlis and Griffith, of the Phœnix Works, Warrington, are the sole manufacturers of the new implement, which is the invention of Mr. Fletcher, the Engineer to the North Western Railway Company.

DESIGN FOR A TELEGRAPH CABLE SHIP.

THE register dimensions for this design are as follows:—Length 230 feet, breadth 32 feet, depth of hold 17 feet, and a gross register tonnage of about 1,000 tons. The ship is specially designed for the purpose of laying and repairing submarine cables, and possessing the most suitable accommodation for those in charge and the crew. The vessel is arranged for a pair of compound (high and low pressure) marine engines, working at 1,100 indicated horse-power, and capable of driving her at a speed of 13·5 knots at sea; they are placed well aft so as to get the principal cable tanks in the fore-part of the ship clear of the screw shaft. The boilers are two in number, of the cylindrical multi-tubular description, and possessing heating surface large enough to supply the engines with all necessary steam. In the boiler-room are two smaller boilers, one or both

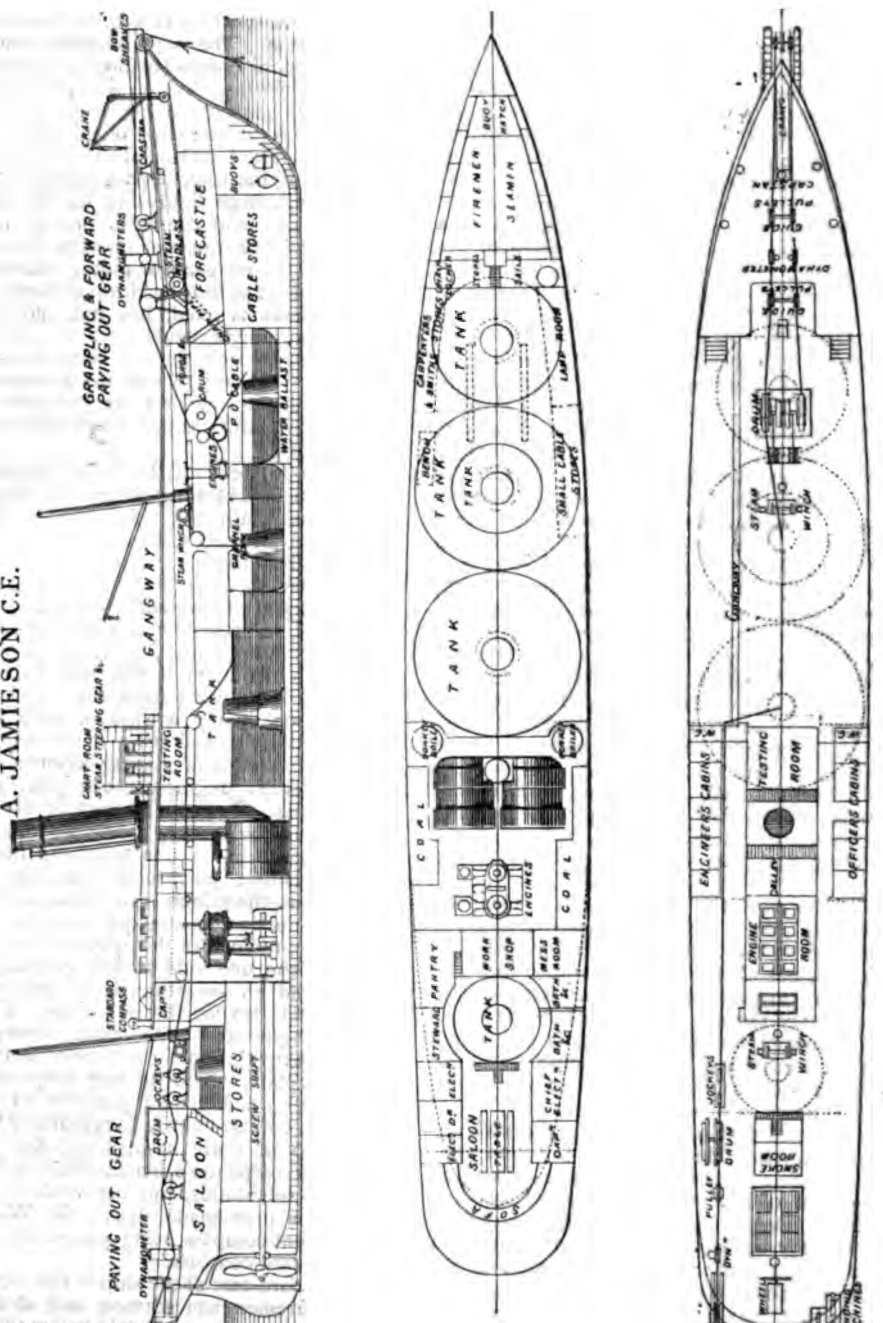
for the ordinary work of the ship's winches, steam capstan, steam-steering gear, &c., and both combined in connection with the forward cable gear. Immediately ahead of the boiler-room is the large main tank, it is circular, and water-tight, right up to the main-deck, with a water-tight manhole on the forward side, which may be opened when necessary, so as to pass cable between decks. In the centre of this tank is a telescopic iron cone suitable for keeping fresh water in, if going on a long voyage. The feed and discharge pipes from this tank, as well as all the tanks, are connected with a special donkey pumping-engine, situated in the engine-room, and under the management of the ship's engineers (deck-pumps, driven by steam winches generating noise, and requiring lengths of hose, being thus avoided). This tank is 31 feet in diameter, and 15 feet deep, and capable of holding 280 knots of deep sea cable without difficulty, and therefore occupies the main cable-carrying capacity of the ship. The next tank has a special feature, inasmuch as it consists of a double tank, placed one inside the other, the outer one being the full width of the ship at this part, while the inner is also circular (18 feet in diameter) and contains the grapnel rope. The small tank forward for the picked-up or other cable is placed on the top of the water-ballast tank, and all three tanks are made as large as the form of the vessel will permit. There is another tank aft, just forward of the saloon, and principally used for holding "shore end," or the heavier type of cable, but it is handy for any kind that may come to hand. The black line going aft from the main tank indicates the cable as it passes through the eye of the tank, over the guide pulleys on deck, through the alleyway on the port side to the jockey machinery, where any tendency to kink is taken out of it, or in other words, it is straightened, before taking three or four turns round the paying-out drum, after leaving which, it passes over a guide-pulley, underneath the dynamometer, and over the stern pulley into the sea.

It will be seen from the deck plan, that the cable, and all after paying-out gear connected with it, is kept well out to the ship's port side; by this means we get all the available space that can be had on the main-deck, either for working the ship or any other purpose. On the other side of the ship, and opposite the stern pulley, is placed Sir W. Thomson's large and small sounding machines, for the purpose of making a careful survey of the bottom of the sea.

At the forward end of the ship is the picking-up repairing gear. Here again a full line indicates the direction of the cable as it is picked up over the bows of the vessel and passed into the double tank. Beginning at the bow sheaves (of which there may be two or three, some telegraph engineers preferring the one number, and some the other), we pass inboard to the dynamometer, which is placed midway between two sets of guide-pulleys, the one on the raised forecastle-deck, and the other on the main-deck, elevated to the same level. This dynamometer, as in the case of the one aft, is used for measuring the strain brought to bear on the grapnel rope or cable. Close to the bow sheaves extends a light iron grating platform for men standing on and manipulating the work of grappling and picking-up, &c. The top of the picking-up drum just appears about 12 inches above the main-deck, while the whole of the machinery, consisting of a pair of strong horizontal engines, is firmly fixed on the lower deck, which is specially strengthened to support them. The engines receive steam from two smaller special boilers (before mentioned), or from the main boiler as desired, while the whole of the starting handles and brake-gear for manipulating the compound right and left-handed gear are so conveniently placed on the main-deck that one man, by watching the large dynamometer scale (which is marked with large figures on its aft as well as its forward side), and the directions of the engineer or officer in charge, can manage them with ease. Suitable draw-off gear for pulling the cable when it has passed the picking-up drum towards one or other of the tanks is fixed, but not shown. A light narrow gangway extends from the bridge-deck to the forecastle-deck for the convenience of those in charge passing to and fro between the chart room and the working or grappling-deck, and this greatly facilitates the observation and guidance of the work.

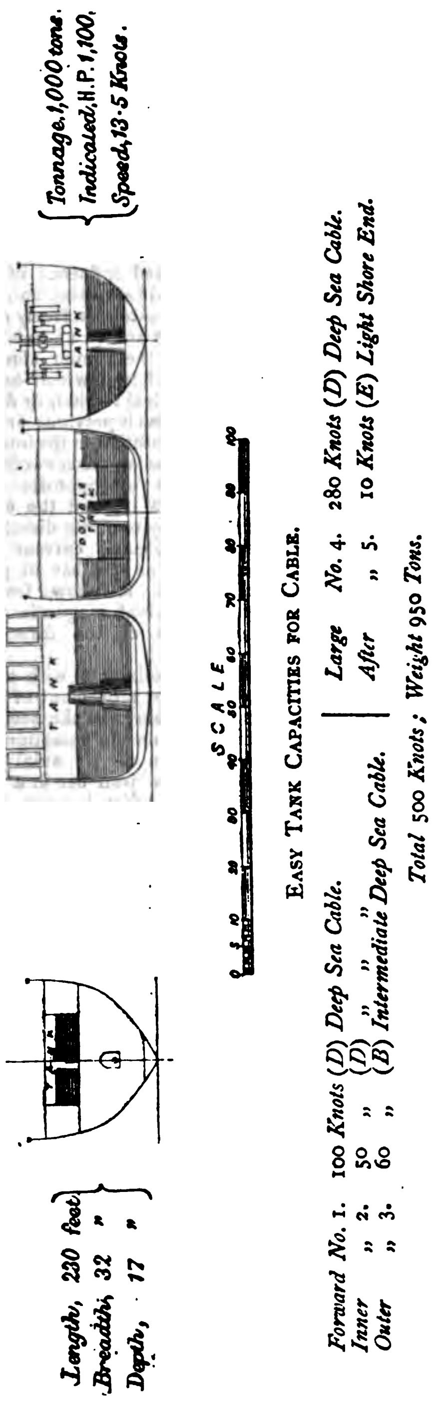
At the fore-end of the boiler casing is a large and commodious testing-room, conveniently situated above the main-tank (fitted with De la Rue's chloride of silver cells, two of Sir William Thomson's marine galvanometers, a set of slides, ordinary resistance boxes, speaking instruments, &c., &c.). On the top of it is placed the steering compass, wheel-house, and chart-room, and aft of the chart-room, and between it and the funnel, is the steam-steering gear, and above that again is the pilot bridge. On the lower deck, entering from the engine-room, is a spacious and handy workshop, fitted up with two lathes, drilling and slotting machines, grindstones, vices, &c., capable of making all necessary repairs for the ship's engines, cable gear, or electrical instruments. On the after-part of the lower deck is the saloon, with state-rooms for the captain and chief electrician on one side, and for the doctor and the other electricians on the other side. Entrance to the saloon is had from a deck-house on the main deck; the after-part of this house forms a smoking-room. In the wake of the small after-tank, on the one side is the steward's room and pantry, and on the other, baths and w.c.'s for the saloon, and also for the engineers. The after-end of the engine and boiler casing above the main-deck is extended to form a convenient deck-house for the captain, where he may keep chronometers, charts, &c., and generally use it as an office or sleeping compartment in dangerous or hot weather. Alongside of these casings are the officers' and engineers', carpenter's, blacksmith's, and boatswain's berths in sidehouses, and the whole is decked over to form a promenade deck; Sir William Thomson's patent compass being placed aft on this deck as a standard compass.

In the fore-part of the ship is the accommodation for the firemen and seamen, and also store-room and sail-room. Immediately below this is situated the heavy chief cable store, while there is a space forward for buoys and large grapnels. The vessel is fitted with a water ballast tank in the fore-hold for the purpose of trimming when at work. On the forecastle instead of the usual cat and fish davits is a light but strong iron crane, placed in the centre of the deck, and made to swing over each



TELEGRAPH SHIP
Designed by
A. JAMIESON C.E.

The rope may be worked by the steam ıs for heavy lifts. It is very suitable for ıg or lowering the anchor or grapnels, or



sting the buoys out of the fore-peak on to ck, and may be easily lowered flat on deck leired. Immediately behind it is the capstan, wrought by a chain from the steam windlass, which is on the main-deck at the break of the forecastle, between the extended wings.

The first consideration in the design has been the separate stowage of as much cable as possible of the different types required, compatible with the size of vessel; secondly, the easy manipulation of the same, whether for paying out or repairing purposes, with large commodious forward working deck; thirdly, great steaming power, so as to arrive on the ground with as little delay as possible; and fourthly, the comfort of those in charge as well as the crew consistent with operations in warm climates.

I have to acknowledge the assistance of Mr. Logan, draughtsman to Messrs. Aitkin & Mansel, shipbuilders, Whiteinch, Glasgow, in preparing scale plans.—A. J.

[The illustration in the foregoing description is from the design shown by Mr. A. Jamieson, Principal, College of Science and Arts, Glasgow, at his lecture on "Laying and Repairing Cables," Naval and Marine Engineering Exhibition, Glasgow. We have so often heard of old steamers being turned into telegraph ships, and going at a snail's pace, with all sorts of inconveniences, that we shall be happy to receive from our readers any criticisms or plans of other cable ships and cable gear. —ED. T. J.]

Correspondence.

TELEPHONE PERTURBATIONS.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—Your correspondent "Induction," in his letter to you dated 23rd ult., raises certain points which, with your kind permission, I shall endeavour to answer very briefly.

First, "Is it correct to say that the wind 'sets up currents' in the wires? Are not these peculiar noises, if they are really caused by the wind, simply waves of sound?" In my previous communication, which you were good enough to publish, I said that these sounds were probably caused by the currents set up in the wires by the vibratory motion imparted to them (in a magnetic medium) by the wind. I think the experiments of M. Gaiffe and others show that these sounds are due to electrical rather than mechanical causes.

Secondly, another series of experiments confirms the accuracy of what I have already stated, namely, that when telegraph and telephone circuits are put to the same earth-plates the working of the former is reproduced in the latter.

The telephones used in the experiments were the Bell and the Gower-Bell.

The resistances of the earth 0·3 and 1·3 ohm respectively, and neither of them ran for any distance alongside wires in actual use.

Thirdly, I have failed to learn that any telephone company, or even the Post-Office, expects its renters to examine the connections of their apparatus when a fault occurs. Not sharing "Induction's" elevated opinion of the average lineman and his detector, I am inclined to believe that, given a few ample practical rules, the renter with his galvanometer could be as much relied upon for making tests and not leaving his apparatus short-circuited. If the renter could do no more than state in his "Advice of Interruption" that

the fault was or was not at his office, surely he would indicate where the lineman should or should not be sent.

But every town and village does not possess its lineman, and it is to renters in such unhappy places that galvanometers would be most useful, saving, as they undoubtedly would, unnecessary visits of the lineman with his "detector," time and inconvenience.

"The cost of the galvanometer and the resistance they add to the circuit are considerations *so important* that even on short telegraph circuits their use has been abandoned."

If I am not misinformed, the case referred to is an isolated one, and although there are no galvanometers, there are two wires between the offices, and at one of the offices there is every facility for testing. Again, if galvanometers are so objectionable on short lines, they must be equally so on long ones, and no mention is made of their removal from the latter or from the short circuits already supplied with them.

Yours faithfully,

TELEPHONE.

MOLECULAR TORSION AND MOLECULAR MAGNETISM.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—Having recently noticed that some of the chief facts in a paper on "Permanent Molecular Torsion of Conducting Wires produced by the Passage of an Electric Current," published in your TELEGRAPHIC JOURNAL of April 15th, 1881, and described in that paper as being "new," and also some additional ones contained in a paper on "Molecular Magnetism" in your periodical June 1st and 15th, 1881, were previously observed and described in a communication on "Electro-torsion" in the Phil. Trans. of the Roy. Soc. for the year 1874, I shall feel obliged if you will make equally known the following remarks.

In the paper on Electro-torsion it was shown that the passage of electricity through an iron or steel wire changes the structure of the metal and communicates to it a permanent molecular twist, and in addition, that this molecular twist produces a visible movement of the free end of the wire turning in the direction of the twist it has received; and thus not only have the molecules in some extraordinary way rearranged themselves into a permanent twist, but have also given external indication of so great a change having taken place. Also that the strain, which remains a constant, instantly disappears or diminishes upon the production of longitudinal magnetism in the wire.

Various other facts, such as the necessity of having a magnetic metal; that the action of electricity in producing a permanent strain in iron is exceedingly quick; that longitudinal magnetisation was also quick in reducing the strain; that a constant movement of the iron wires of telegraphs by this electro-torsional action tends to occur; and that these torsional states are related to electro-magnetic sounds, &c., &c., are there recorded. The following are some quotations from that paper:—

Page 531. "The torsions may be produced:—(1st) By the passage of axial currents alternately in opposite directions; (2nd) by the alternate passage of coil currents and axial ones; (3rd) by the simultaneous passage of both; and (4th) by the temporary passage of an axial current during the continuance of a coil one, or *vice versa*. The first and second methods yield only very small torsions, and the third and fourth produce exceedingly large ones."

Page 532. "I tried wires of platinum, silver, copper, lead, tin, cadmium, zinc, magnesium, aluminium, brass and German silver, also a zinc rod 2·75 mm. long and *11 mm. thick*, and applied the currents in various ways, *but obtained no signs of torsion.*"

Page 532. "The law of the phenomena in iron is as follows:—A. *With an axial current.* A current following from a south to a north pole produces a left-handed torsion, and one from a north to a south pole produces a right-handed one. B. *With a coil current.* A coil current with its north pole below, circulating round a vertical rod of iron through which an electric current proceeds upwards, produces left-handed torsion, and a reverse one produces right-handed torsion, in the sense already employed.

"Each of these laws, but the latter one the most frequently, is affected in a very limited proportion of cases by the order of succession in which the currents are applied."

Page 533. "Torsions produced by electric currents only are reversed by reversing either of the currents, but those produced by the combined influence of a coil current and previous mechanical twist were not."

Page 534. "To produce electro-torsion freely requires the application of a coil current and of an axial one in the iron itself, and although the former alone, only slightly twists a bar or tube of iron which has been previously subjected to mechanical torsion, or does not twist it at all if it is free from such previous strain (*see* p. 533), it leaves a residuary condition in the iron which renders the bar capable of being afterwards freely twisted in opposite directions by opposite electric currents passed axially through it; and the opposite magnetic polarities conferred by opposite directions of the coil current enable an electric current passed axially in one direction through the bar to produce opposite directions of torsion. It follows from this, that the direction of longitudinal magnetic polarity can be ascertained by means of the direction of electro-torsion.

"As in each of these experiments with an axial current in the iron itself the first movement of torsion in either direction was a large one, and the needle only slightly returned towards zero on the cessation of the current, the temporary action of an axial current succeeding a coil one leaves an iron bar in a twisted state, and the direction of the twist is opposite with opposite directions of the axial current. The results also show that when torsions are produced by this method, detorsion is prevented by some coercive or retaining influence within the bar itself, and thus potential mechanical power becomes stored up in the iron."

Page 536. "In every instance in which torsion occurred there was sound emitted, and in every case where no sound was produced no torsion took place; probably, therefore, the two phenomena are mutually related, and the torsion is dependent upon the cause which produced the sound."

Page 536. "It is manifest from a consideration of the torsions and sounds that an electric current passed through iron in a more or less magnetised state produces a molecular movement and a change of position of its particles, and that the new position continues as long as the current. Also that on the cessation of the current the particles make very little movement, and return only a small extent towards their original positions, because little or no sound occurs, and only a small amount of detorsion then takes place. Also that an electric current in the opposite direction produces a similar set of changes, except that the changes are in the reverse direction."

Page 537. "It must not be forgotten that in all these experiments terrestrial magnetism operates, and more or less influences the results; also that the iron is liable to have its residual magnetism weakened by the repeated passage of an axial current in either direction through it, and if the lower end of it is a north pole, the polarity is often reversed. A single contact of the

attery is sufficient to remove the polarity if the arrent is powerful and the iron wire a small one.

"In consequence of not being able to maintain a bar r wire of iron perfectly free from longitudinal magnesm during the passage of an axial current through it hilst in a vertical position, and the difficulty of detectig minute torsions with the bar in a horizontal one, was unable to ascertain if an axial current alone ould produce torsion by experimenting with a deagnetised iron bar at right angles to the magnetic eridian. But as the magnitudes of the torsional ffects of an axial current increase with the strength of ae longitudinal magnetic polarity of the iron, and pposite longitudinal magnetic polarities enable each xial current to produce opposite torsions, it is highly robable that if a vertical iron rod or wire could be aintained in as perfectly a magnetised state in a ongitudinal direction as it can in a transverse one, an xial current alone, like a coil one alone (*see* p. 533), ould produce little or no torsion."

Page 540. "The sudden cessation of torsion after the rst axial current in steel, and the much more gradual ssation of it in iron, are quite conspicuous. The ict that the magnitudes of the first torsions, both in on and steel, are smaller with a north pole below ian with a south one, agrees with the view that the agnitude of the movements depends upon that of the siduary longitudinal magnetism."

Page 541. "To produce torsion freely requires the ro currents (*see* section 10, p. 535), and, although each arrent alone will produce its own magnetic effect, either alone will twist the bar if the iron is free from iechanical strain. The results also show that, although coil-current alone produces no torsion in an annealed on bar (*see* p. 533), the previous passage of a current tially through the bar puts the iron into such a magtic state that it becomes capable of being afterwards eely twisted in opposite directions by opposite coil urrents, and that opposite axial currents cause the iron assume two opposite directions of such state, because ey enable one direction of coil current to produce pposite directions of torsion. The results further show at the two ends of an iron rod, wire, or tube, through hich an electric current has been axially passed, ssess opposite properties.

"It appears, also, that each of the opposite longitunal magnetic states produced by the two directions of il current is different from each of the conditions oduced by opposite axial currents, because previous agnetisation of an iron bar by a coil current in either rection did not enable the subsequent magnetisation that bar by an opposite coil current to produce ist, whereas the previous passage in either direction an axial current through it did enable such subquent treatment of it to produce torsion; and, further, cause an axial current does not lengthen an iron bar e p. 530), but a coil current does; the acoustic ects of the two directions of current are also different mpare section 12 and 23). All these conclusions ree with the view that the axial current imparts leless magnetism tangentially to the outer layer of lecules of the iron, and that each of the four diffeit directions of current imparts to the free end of iron a different property.

"As in each of these experiments with a coil current first movement of torsion was a large one, and the lex returned only a small distance back on cessation the current, the temporary action of a coil current ceeding an axial one (like that of an axial current ceeding a coil one, *see* section 10) leaves an iron in a twisted state; and the direction of that twist pposite with opposite directions of the coil current. this method, therefore, as well as by the previous e (*see* section 10), detorsion is prevented by some influence within the bar, and mechanical power becomes stored up.

"The results of these experiments, and of those previously described (*see* section 10), show that the direction of torsion in all of them depends upon that of each of the two currents, and that it was reversed by reversing either the axial or coil current, but not by reversing both. They also prove that the directions of torsion produced by a coil current succeeding an axial one are identical with those produced by an axial current following a coil one."

Page 542. "The magnitudes of the torsion produced by coil currents succeeding axial ones averaged about two-fifths of those produced by axial currents succeeding coil ones."

Page 543. "The magnitude of the torsion produced by a given current depends not only upon the kind of current which immediately precedes it, but also upon the description of current which precedes that one. An axial current in a given direction succeeding a coil one nearly always produced a greater torsion if the coil one was preceded by an axial one in the opposite direction than if it followed one in the same direction. A similar but less general result occurs with coil currents succeeding axial ones.

"Alternate coil and axial currents, therefore, produced the largest torsions when both kinds of currents were alternately reversed in direction. The torsions in general produced by alternate currents appear to be due not only to the energy of the acting current, but also to the liberated potential energy of the residual magnetism left by previous currents."

Page 544. "In every instance a coil current acting alone produced a sound, both at its commencement and termination, the former being the loudest and the latter more metallic; and by repetition of the current in the same direction the two sounds were more feeble. Coil currents succeeding axial ones also produced sounds both at their commencement and cessation, the former being in every case louder and more dull, and the latter feebler and more metallic (*see* also section 24), and by repeating the coil current in the same direction the two sounds were more feeble.

"The residuary axial current state is destroyed by a red heat, and is but little restored by cooling the wire whilst in a direction at right angles to the terrestrial magnetic meridian."

Page 545. "As an axial current passed through a recently annealed rod of iron or steel leaves it in a different physical state (without twisting it), and one succeeding a coil current leaves the bar in a twisted condition, it is evident that iron possesses a retentive power, not only for the influence of a coil current, but also for that of an axial one, and that the residuary axial current state may exist with or without the condition of twist.

"In consequence of this retentive power of iron and steel for those effects, both the direction and the magnitude of the torsions in every case depends not only upon the kind and direction of the currents being applied, and upon the condition of the rod with regard to previous mechanical strain, but also upon the state of it with regard to both those residuary influences."

Page 546. "It required more persistent treatment to remove the residual effect of a coil current than that of an axial one, probably partly because the influence of terrestrial magnetism assisted in maintaining the former and in removing the latter.

"Although it requires a *series* of alternately opposite axial currents to remove the residual effect of a coil one, and a *number* of alternately reversed coil currents to remove that of an axial one, a single opposite coil current, also a single opposite axial one, each of sufficient power, respectively produce those effects. It

would appear from this that the two states produced by opposite coil currents (or axial ones) are incompatible and cannot co-exist, and that a coil current acts in a more mechanically advantageous way in obliterating the effect of an opposite coil current than in removing that of an axial one, and an axial current acts more effectively in effacing the influence of an opposite axial one than in reversing or removing that of a coil one."

Page 547. "The residual effect, both of a downward and of an upward axial current, was much more persistent in steel than in iron, and we may conclude that steel possesses in a greater degree than iron a coercive power for the influence of an axial electric current."

Page 548. "The magnitude of the first torsion produced by a current is specially liable to be affected by various mechanical and magnetic conditions of the axial wire or rod, which may be very readily overlooked."

Page 549. "The largest torsions were produced by axial currents, and the smallest by coil ones; therefore the former left the smallest residual effects."

Page 552. "As real torsion and detorsion can only be detected and measured by the aid of a proper zero-point, it is necessary to have the wire well annealed and free from magnetism and mechanical twist before commencing a series of experiments, and not to disturb the zero-point by mechanical motion of the apparatus. A very effectual way to remove the residual effects of both coil and axial currents is to heat the rod or wire to redness whilst in a direction at right angles to the magnetic meridian, and allow it to cool in that position without disturbing it (*see* section 24). A more convenient but less perfect way is to repeatedly and simultaneously pass a coil current producing a south pole below, and an axial one of proper relative strength (*see* section 37, p. 555), and stop the two currents simultaneously; the pointer will then settle very near zero, and the wire will only possess the usual magnetism induced by terrestrial influence.

"The two conditions, or rather directions, of magnetic condition were observed to co-exist in the same wire in many of the experiments. All rods or wires of iron or steel in which there remained the effect of an axial current were at the same time in a more or less longitudinally magnetic state by the influence of terrestrial magnetism, and could then be twisted by the application either of a suitable coil current or of an axial one.

"The view that the two conditions are to some extent distinct and independent agrees with the fact that a suitably powerful coil current *at once* removes and reverses the residuary longitudinal magnetic polarity in a soft iron wire, but only gradually removes the residual effect of an axial current, and does not at all reverse it (*see* section 27). Each axial current also transmits its own characteristic influences through several subsequent coil current changes, and each coil current similarly through axial current changes, in a kind of hereditary manner."

Page 553. "There was a special difference between the torsions produced by alternate currents and those yielded by simultaneous ones. In the former case, on cessation of the current, the pointer only slightly returned towards zero, and the wire remained twisted (except in a limited number of special instances, *see* section 20, p. 542, and section 32); on repeating the current in the same direction only the small elastic torsions occurred, and the large movements in the same direction could only be obtained by reversing the current, and then again repeating it in the original direction. But with the two currents flowing simultaneously, on stopping them the index returned nearly to zero, and the wire did not remain twisted; on re-*peating the currents in the* same direction the very large torsion in the original direction was again produced; and any number of such torsions could be consecutively obtained without any intervening reversal of the currents. It is evident, therefore, that the coercive force or condition within the bar which retains the iron in a twisted state after the passage of alternate coil and axial currents is either overcome or does not operate when simultaneous currents are employed."

Page 554. "The very much greater magnitude of the torsions obtained by simultaneous coil and axial currents was probably a consequence of the two magnetic conditions being very much stronger during the continuance of the currents than after their cessation. Not unfrequently with an iron wire 1·75 mm. thick the first movement of the index exceeded 25 millimetres. The torsional push is not limited to a small angle, but continues through the entire range of the largest arc through which the pointer can be made to swing, even though that exceeds one-third of a circle."

Page 554. "With the two currents commenced together and terminated also simultaneously, the index made a very large movement at the commencement of the currents, remained considerably (though much less) deflected during their continuance, and returned nearly to zero on their cessation, provided the two currents were of proper relative degrees of strength."

Page 555. "Simultaneous and divided currents on the first time of passing produced a loud and dull sound on making contact, and a weaker and more metallic one on breaking contact, but by each repetition in the same direction the reverse, and their first passage produced louder sounds than their repetitions."

Page 555. "As the magnitude of the torsions produced by simultaneous currents depends upon both currents, and is therefore limited by the weakest, the two currents must be properly proportioned to each other in order to produce the maximum degree of torsion."

Page 556. "Iron is extremely susceptible of being affected by an electric current, and consequently every different way of applying the two currents produces a difference of effect upon it."

Page 557. "A non-magnetised iron wire is not visibly twisted by a powerful coil current (nor axial one) alone, but acquires an invisible potent condition which reveals itself by torsion on the subsequent passage of suitable currents."

Page 557. "A general review of the phenomena described in this paper shows that the hereditary action and order of succession of the various currents affects the torsions in all cases."

Page 558. "It would appear from the results obtained that in iron the residuary torsional influence of the currents generally is about one-tenth of that exerted by them during their continuance. In steel it would be a much greater proportion in consequence of the comparative smallness of the torsions yielded by that substance with simultaneous currents."

Page 559. "Except with alternately opposite coil currents succeeding an axial one, iron is much better adapted than steel for producing large torsions.

"It is probable that the generally smaller torsions obtained with steel than with iron was partly due to the greater degree of mechanical resistance which that substance offers to torsion, and partly to its differences of magnetic properties and chemical composition. Electro-torsion, therefore, affords prospectively a new method of investigating the mechanical and magnetic properties and the chemical composition of magnetic metals."

G. GORE.

CITY AND GUILDS OF LONDON INSTITUTE EXAMINATIONS.

To the Editor of THE TELEGRAPHIC JOURNAL.

DEAR SIR,—The results of the Examinations for 1881 have just been issued, and are far from encouraging, either to teachers or students after six months' work. In my opinion, this result is chiefly due to the limited instructions issued to teachers. I would ask, why cannot a printed syllabus be issued, stating how far the students in each grade will be examined? This is done by the Science and Art Department, and the results are far more encouraging, as all know their work and do it, instead of rambling about in the dark all over a subject, as is the case at present, instead of concentrating all their attention each session on what is really required. It is to be hoped something of the kind will be issued for future guidance.

Yours truly,

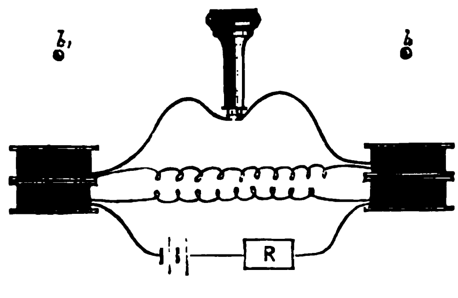
A STUDENT.

Notes.

THE BROOKS' UNDERGROUND SYSTEM.—On page 306 we give an account of the tests taken on the new length of this cable, put down between Vauxhall and Clapham Junction. The importance of this system appears to be growing from day to day. Its inventor claims for it, and justly so we think, that it has the following advantages, viz:—1st. Durability when compared with all other kinds of insulation. 2nd. Economy, because the ordinary number of conductors at present in use upon the railways in Great Britain could be renewed by this system at a less cost than by overhead wires. 3rd. That the chances of interruption in comparison with overhead wires are enormously lessened. 4th. That the insulation of the wires is uniform, and (by the use of oils of various insulating properties) can be raised or lowered at pleasure. 5th. That low inductive capacity can be simply and cheaply obtained by enlarging the jute covering, thus enabling long circuits to be worked at a high speed by automatic means. The above *desiderata* will, we think, be deemed important, and the system seems to bring into view a near future, when unsightly, and ever increasingly dangerous, overhead wires will be among the things of the past, and when probably telegraph rates will, through increased speed and economy, be reduced from one shilling to at least half that price.

PORTABLE ELECTRICITY.—At the Academy of Buda-Pest certain experiments with stored-up electricity were lately conducted in presence of the professors, members of the administration, &c. It is said to have been proved that electricity can be stored up just as well as light, gas, steam, &c., and that it can be transported in this state. The experiments were conducted with 50 Faure's accumulators, and consisted in igniting platinum and iron wires, the production of electricity and its effects, and in the conversion of electricity into mechanical work. With these accumulators and with the help of a Gramme machine, a circular saw was set in motion and several logs of wood were cut up. The French firm who had these experiments performed maintain that the expense is 10 kreuzer per horse-power per hour.—*Oesterr Ungarische Post.*

THE LOCALISATION OF THE BULLET IN PRESIDENT GARFIELD'S BODY.—The daily papers have announced that success has attended the method suggested by Professor Hughes for localising the bullet in the body of President Garfield. The arrangement for effecting the object in view is of a very simple nature, and can be easily understood by reference to the figure. Two induction coils, each having a primary and secondary wire, have their primaries connected in circuit with a battery and a rheotome (R), so that a number of current pulsations are continually flowing through the primaries. A telephone is joined in circuit with the two secondary wires, the connections being so much that the induced currents from the secondary coils tend to oppose each other and produce silence in the telephone. If now a bullet or mass of metal be brought near one of the



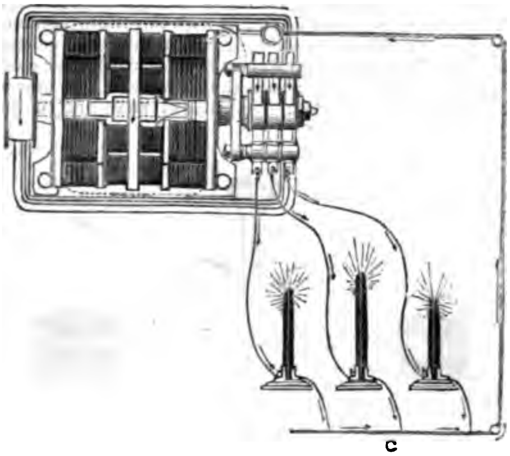
induction coils, the inductive effect disturbs the equilibrium of the arrangement, and sounds are heard in the telephone, which sounds will be a maximum when the mass of metal is nearest the coil. By adopting, therefore, the arrangement shown in the figure, and moving the left-hand coil over the locality of the bullet, b_1, in the President's body, the point at which the sound was heard to be loudest indicated the nearest point to the bullet. To ascertain the depth of the latter from the surface, it was only necessary to hold a second bullet, b, near to the second induction coil, and then to advance or retreat it until silence in the telephone was produced, when the distance of b from the coil indicated at once the depth required. We must congratulate Professor Hughes on the success of the experiment.

CHROMIC ACID ELEMENT.—Chromic acid elements have the great advantage of simplicity, and their consumed portions are easily replaced, but the consumption of materials is in all cases disproportionately great. The reason of this defect is that on the contact of the zinc with the sulphuric acid of the chromic acid mixture, hydrogen is evolved and is then oxidised to water by the oxygen of the chromic acid. If this secondary process can be suppressed the mixture is at an end. By the decomposition of chromic acid by the hydrogen evolved in the element there is formed potash chrome-alum. This salt has a higher specific gravity than the solution of chromic acid, and sinks to the bottom along with the solution of sulphate of zinc.

If, therefore, the zinc is laid at the bottom of the glass jar, it is protected from direct contact with the chromic acid. Instead of a zinc plate it is better to use a liquid zinc amalgam, which may be placed in a small, shallow beaker in the bottom of the jar.

Such elements last very long; they are powerful, and if the surface of the carbon is large enough, more powerful than the Leclanché element, and cheaper—*Zeitschrift für angewandte Electricitäts Lehre.*

A patent for a dynamo-electric (No. 243,746, dated April 7th, 1880) has recently been taken out in the United States by Mr. J. J. Wood. In this machine, which is shown by the figure, the circuits from the armature-sections are taken separately to the lights or other working devices, then, by a common return-conductor, back through the field-magnets to the opposite ends of the armature-sections. There is an armature



formed with a series of two or more distinct coils or groups of coils, and a commutator having corresponding sections, with collecting and transmitting springs which can be combined with a series of two or more lamps each connected on one side with one of the springs on one side of the commutator, and all connected on the opposite side to one common or main conductor connected with the several springs.

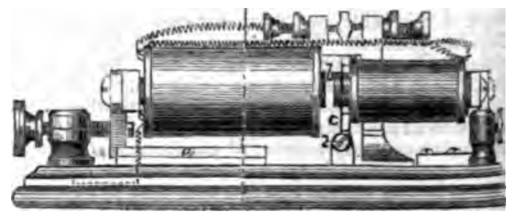
Galvanic Dissolution of Gold.—Grotthus, in his experiments on the decomposition of water by means of the battery, observed the solution of a gold wire used as a positive pole in sulphuric acid traversed by the current. Berthelot has recently repeated this experiment with the same results. Sulphuric acid, diluted to one-tenth, turns yellow and rapidly dissolves a gold wire. The dissolved gold may easily be detected by means of stannous chloride, and a part of the gold is deposited at the negative pole. The attack of gold by means of sulphuric or nitric acids is not due to the intervention of ozone, but simply to the electric current.—*Il Progresso.*

Unity in Electric Measurements.—The want of an international system has been strongly felt, and the multiplicity of the measures in use is alarming and confusing. We find electromotor forces expressed in Daniell, Grove, Bunsen, Regnault, Volt, Siemens x Weber, &c.; strengths of current in Jacobi, Weber, $\frac{\text{Daniell}}{\text{Siemens}}$, $\frac{\text{Grove}}{\text{Siemens}}$, &c. Those measures are particularly unhappy which are compounded of heterogeneous systems, *e.g.*, Siemens x Weber. We generally console ourselves with the thought that 1 S. E. is about as much as 1 Ohm, 1 Daniell about equal to 1 Volt, and 1 $\frac{\text{Daniell}}{\text{Siemens}}$ approximately equal to 1 Weber, though we here commit an error of 7 per cent. What would be thought of an engineer who mixed up Rhenish and English measures? We must admit that the introduction of a universal system of electric measurement is extremely difficult. Measures of length and weights are produced with great uniformity and certainty by our wardens of the standards, but the preparation of normal electric measures is far more difficult. Above all, a trustworthy normal element is wanting. In order to produce anything useful, it would be necessary to intrust an international committee with the arrangement and management of the manufacture of such normal elements. If the conditions for attaining equality and constancy of the electromotive forces were once thoroughly understood, it would be possible for a carefully-conducted manufacture to supply the whole world with a suitable measure. Standard galvanometers could also be supplied.

A further task for a congress of electricians would be the establishment of symbols to be used in equations for the different measures.

Not merely in the system of measurement, but in electric terminology there is enough confusion. The term intensity is applied by one authority to the strength of the current, and by another to the electromotive force of the electromotor. Others use the words: tension, electromotive force, and potential difference in manifold confusion.—*Zeitschrift für angewandte Electricität.*

The figure here given represents an electromagnetic apparatus patented in the United States (patent No. 244,035, dated February 9th, 1881) by Mr. Moses G. Crane. In this apparatus there is a main electro-magnet and induction coil, the primary coil of which is in the main circuit, combined with the inde-



pendent retracting-magnet in circuit with the secondary coil of the said induction-coil, whereby a magnetic impulse is produced in the said retracting-magnet when the condition of the main current in the primary coil is changed, so that the effect of a reversal in the main current is effected although no reversal takes place.

Reynier's Constant Element.—The liquids used in this battery have been till lately kept secret. The zinc plate is immersed in a solution made up as follows:

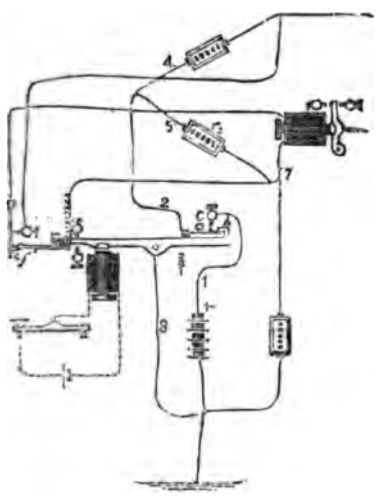
1,200 parts water, 300 parts carbonate of soda, 100 parts carbonate of potash, 20 parts chloride of potassium, 20 parts chloride of sodium, 20 parts "kalium-chloride" (merely another name for chloride of potassium), and 20 parts common salt! (Which is of course the same thing as chloride of sodium.)

The copper plate is placed in a still more complicated mixture of 1,200 parts water, 240 parts blue vitriol, 60 parts nitrate of copper, 20 parts chloride of potassium, 20 parts chloride of sodium, 20 parts "kalium chloride," 20 parts common salt (a repetition of the blunder above mentioned), 20 parts saturated solution of chloride of zinc, 20 parts sulphate of potash, 20 sulphate of soda, and 20 sulphate of zinc. (We cannot compliment M. Reynier on his chemistry.)—*Zeitschrift für angewandte Electricität.*

The Cunard s.s. *Servia* is being fitted with 98 of Swan's electric lamps.

A PRACTICAL APPLICATION OF THE TELEPHONE.—By M. Lindner.—Whoever has to do with telegraphic connections knows that, notwithstanding the most careful arrangements, disturbances often occur which are manifested by a rapid falling off in the action of the batteries employed. The causes of these by-contacts are often so hidden as not to be easily discovered. The case may be mentioned where this phenomenon is due to damp walls and single damp stones, and makes itself perceptible in spite of the wires being carefully infolded. This kind of connection cannot be detected with the ordinary galvanometers, and the well-known and certainly sensitive "testing experiment" throws no light upon the cause. In all such cases the telephone may be usefully applied by simply introducing it into the circuit, and alternately making and breaking contact. We hear then, even with the feeblest currents, a gentle ticking, which in stronger currents becomes a loud cracking, and can then seek for its cause. The author in all such cases makes use, with great advantage, of a sensitive telephone, which has the further advantage that it is much more portable than a delicate galvanometer.—*Zeitschrift für Angewandte Electricität.*

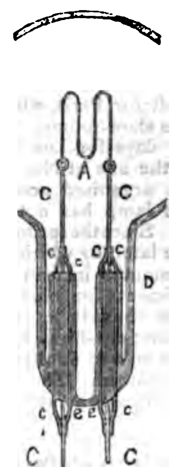
MR. STEPHEN D. FIELD, of New York, has recently patented a device (patent No. 244,218, dated June 8th, 1881) for getting rid of the effect of the static discharge on long duplex lines without the aid of condensers. In this arrangement, which is shown by the



figure, the receiving instrument is short-circuited and the bridge-wire (in which said receiving instrument is located) is broken for an instant both on the opening and closing of the home-transmitter, thus preventing false signals on the receiver.

STORAGE OF ELECTRICITY.—The Cleveland, Ohio, *Trade Review* says that Mr. Charles Brush, well known in connection with electric lighting, has invented what is at present probably the best system of storage yet devised. It adds:—" All as yet known is that metal is used as the recipient by Mr. Brush of the electricity to be stored. It is an important part of the invention that the electricity can be stored for any length of time, awaiting the occasion for use. Mr. Brush recently stated that he was able to store double as much electricity as Faure in a given space."

THE electric lamp shown by the figure has been patented in the United States (patent No. 244,277, dated December 8th, 1880) by Mr. Hiram Maxim, and it consists of a continuous incadescent conductor inclosed in a transparent vacuum-globe in combination



with conducting wires leading to said conductor, each of which is divided where it passes into the globe into two or more branches, to which the material of the globe is directly sealed by fusion.

WESTERN UNION AND AMERICAN UNION TELEGRAPH CONSOLIDATION AND THE CABLE COMPANIES.—Judge Blatchford, of the United States Circuit Court, sitting in New York City, denied the motion made on behalf of the French cable company for an injunction restraining the telegraph consolidation and the closing of the offices of the American Union Telegraph Company, with which the cable company had contracts, that, as it alleged, the consolidating companies could not carry out. He also said, " If hereafter damage is shown to result to the French Cable Company from the sending by the Western Union Company of unconsigned messages over some cable other than a cable of the plaintiff or of said other two cable companies, it may be proper to ask the interference of a court of equity. In such case the question of the existing mutuality of the said agreement will come up for consideration with the questions whether said agreements belong to a class of which specific performance will be decreed, and what control the Court could have over the plaintiff to compel it to observe the agreements on its part."—*Journal of the Telegraph.*

THE EDISON ELECTRIC LIGHT.—The New York *Evening Post* gives the following account of what Edison is doing: " The Edison Electric Light Company has almost finished its work in its first district—that bounded by Nassau Street and the East River, Spruce and Wall Streets—having already wired five hundred houses, and the number of men at work in the district has been reduced from eighty to forty. The eight hundred houses in the district will require about thirty thousand lamps. The mains are laid in most of the streets, and all that is needed to begin lighting by this system are the engines, which are promised by the middle of September. Mr. Edison expects that the first illumination by electricity upon a large scale will take place about the middle of October. The contract

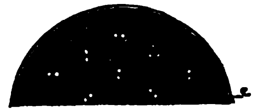
made between the company and householder is that the new light shall cost no more than gas. As it is expected to be in every way superior to gas, there has been no hesitation in accepting the offer. For the last two months Mr. Edison has been busily at work upon what he is going to show at the Paris Exhibition of Electricity. Every outgoing French steamship carries a number of boxes full of machinery from Edison's workshops. One hundred and thirty-seven boxes left last week, and to-morrow's boat will take one hundred more. Mr. Batchelor, with eight assistants, has already left for Paris, where he will remain in charge of Edison's show-rooms. Mr. E. H. Johnson will leave in a few days for London, where a model station, similar to the one at No. 165, Fifth Avenue, in this city, will be organised according to Edison's plans. The Edison lamp has not yet been properly exhibited in London. Since the spring, a change had been made in the Edison lamp by which the lamps last an average of seven months instead of four, and one horse-power is sufficient for nine instead of seven lamps. The change consists in reducing the size of the carbon thread about one-fifth. Improved machinery has enabled Edison's men to do this without impairing the perfection of the thread. The Menlo Park factory is now turning out from nine hundred to eleven hundred lamps a day.

THE Cleveland, Ohio, *Trade Review* states that "the Brush Electric Company's Works, occupying six acres of ground in Mason Street, Cleveland, at the crossing of the Cleveland and Pittsburg Railroad, are the largest electric works in the world. The buildings first erected, and which consisted of a main machine shop 265 by 122 feet, with proportionate large boiler room, blacksmith shop, japanning oven, carbon factory, tool, carpenter and tin shops, have since had important additions. The machinery used is of the most perfected description. The engine driving it is 400-horse-power. In the boiler room are three enormous boilers of Otis steel. They were built by the Variety Iron Works and the Cleveland Steam Boiler Works. The carbon department proves one of the most interesting to visitors. Here are furnaces in operation for the burning of the carbons. Provision is made for 36 furnaces, each of a capacity of 10,000 carbons, capable of turning out 75,000 carbons per day. The plant for the grinding, mixing, moulding, pressing, plating and packing is on a corresponding scale. Three powerful hydraulic presses are in use. Such is the pressure of orders that a new machine shop 410 by 100 feet and an iron foundry 265 by 100 feet is to be added. Some of the material is now on the ground. The buildings are to be of brick, and one storey in height, thus securing the highest amount of solidity and entire freedom from vibration. With the completion of the buildings they will be capable of affording accommodation for 1,500 men, and of turning out from 8,000,000 dols. to 10,000,000 dols. worth of work per annum. On a separate piece of land, facing the works, a laboratory has been erected, in which Mr. Brush will pursue his investigations. Mr. George W. Stockly is the business manager of the company, and Mr. N. S. Possons the superintendent."

THE deaths from lightning in Italy during the years 1864 to 1879 average 119 annually. The highest number was 237 in the year 1868—a year which, in England, was singularly free from thunderstorms—and the lowest was 54, in the year 1866.—*Zeitschrift für angewandte Electricitäte.*

TELEPHONIC REPORTING.—It is well known that at *the Times office* the telephone has become of great use *in reporting directly* between the Houses of Parliament and Printing House Square. The proprietors of the *Oldham Express* have followed this example, and have, through Messrs. Moseley and Son, had their offices placed in communication with the offices of Messrs. Dodds and Story, shorthand writers and reporters, of Manchester. The wire is twelve miles in length, and runs close to many other post office wires, and speaking is said to be carried on as easily, as audibly, and as fluently as if addressing a person in the same room. Mr. W. F. Bottomley was the engineer.

TELEPHONE CIRCUIT.—Professor Alexander Graham Bell has patented in the United States (No. 244, 426, June 4, 1881) a cable composed of a number of strands,



each consisting of insulated wires arranged as shown in the figure, the wires of each strand being equidistant, or practically equidistant, from the wires of other strands.

TELEGRAPH STAMPS.—Mr. Fawcett, M.P., writing to a Welsh correspondent, remarks that the question of abolishing telegraph stamps has been for some time under his consideration, but he has not been able yet to come to a decision.

THE INTERNATIONAL MEDICAL CONGRESS.—On Tuesday, the 9th instant, many of the members started from Charing Cross Pier, in a large paddle-wheel steamer specially provided for the purpose by Messrs. Siemens Brothers and Co. The object was an inspection of the famous telegraph cable ship *Faraday*, and the equally famous Woolwich works. The visitors had an opportunity, therefore, of seeing how the telegraphic cable is made, shipped, coiled away, and paid out of the ship named after Mr. Siemen's old friend, Faraday. About 300 gentlemen took luncheon in the works.

ELECTRIC LIGHTING AT RAILWAY STATIONS.—Our contemporary, *Engineering*, quotes the following data from the current number of the *Bulletin du Ministère des Travaux Publics*, on the lighting by electricity of large railway stations in Germany and France. The Eastern railway station at Berlin, a large hall 616 ft. long and 114 ft. wide, has been lighted since September, 1879, by 14 lamps, placed 23 ft. above the platforms, and supplied by a 10-horse engine. The installation was made by Messrs. Siemens, of Berlin, who supply the light at a charge of 9 fr. 22 c. per hour, or ·658 fr. per hour per lamp. The Anhalt station at Berlin, 820 ft. long, 205 ft. wide, and 95 ft. high, is lighted by 20 lamps suspended at a height of 21 ft. 3 in. above the platforms. The cost of first establishment, not including motive power, was £1,350. At Düsseldorf the large vestibule of the station, and one platform 492 ft. long, is lighted by electricity, the cost per hour and per lamp being ·311 fr. The new station at Munich, not yet completed, will be lighted by 45 lamps, divided into 9 circuits and worked by 4 gas engines. In France electric lighting has been employed at the Northern station since 1875, and at the Lyons station since 1877. The nightwork done at the Chapelle station is very important, and in winter often amounts to 15 or 16 hours per day. It was to obtain a better light and increase the work done which fell at night to one-half

done in the day that the Northern Company in 1875 to try the electric light. The installa- sisted of 5 Gramme magneto-electric machines, g 2·5 horse-power, and costing £60 each. As d at a height 18 ft. or 20 ft. each lamp lights an 200 ft. radius sufficiently for all the requirements :. Each of the lamps when working for ten ›sts ·556 fr. per hour. If interest and a sinking added, the price rises to ·80 francs, that is to the standard price of gas. The Paris, Lyons, diterranean company, after having a series of tory trials, which lasted for 45 days in 1877, . the Lontin system to light the goods sheds of ıst traffic. The installation, costing £1,880, es 18 lamps, the cost of which, including all over a service of 4,000 hours a year, is ·295 fr. r per lamp, or including interest at 10 per cent., which is about the cost of ten gas jets. The ·room of the Saint-Lazare station is also lighted t of ·65 fr. per hour.

ıURE in the English patent for his secondary makes the following claims:—1st. The im- secondary batteries, enabling a large quantity ro-chemical force or energy to be stored up in a ›ace and small weight, substantially as herein- described. 2nd. The process of obtaining r supports capable of retaining and preserving :hemical force or energy by covering them with of porous or spongy metallic matter deposited desired thickness by galvanising chemically ating, or mechanical adhesion, substantially as :fore described. 3rd. The employment of of india-rubber, felt, and other suitable ls for maintaining and holding up to or against ›orting plates the coating or layer of metallic :e mixed or not with inert matter, substantially nbefore described. 4th. The combination with ed carriage, or other vehicle, or boat, or barge, :lectro-dynamic machine carried on the said or vehicle, and a secondary or polarisation capable of being recharged at the end of a substantially as hereinbefore described.

E'S SECONDARY ELEMENT.—This apparatus, *itschrift für angewandte Electricität*, is now less favourably. The question is raised whether : not be more advantageous to convey the elec- through conductors instead of, so to speak, ; it into bottles. There are circumstances ›ermit a comparison. We have, *e.g.*, portable rell as gas mains. The former system is much German railways, and does good service, but it rer supersede the distribution of gas in towns ıs of piping. This comparison, indeed, is not :rfect, for in Faure's accumulators electricity is d in the form of potential energy, whilst in ors it takes the form of actual energy. But tems can be combined by fitting up large Faure ators at a central station, which can be con- illed, and thus the production of electricity by -electric machines can be made independent of : of its consumption. Whether this plan will be ble and useful the future must show. The fol- *lata* can be given as to the performance of accumulator. According to the experiments of and Hospitalier, a Planté element can store o kilogrammetres per kilo. of lead. Reynier, aure elements, succeeded in keeping a platinum metres in length and 0·0012 metre in thick- a red heat for 100 minutes. From this experi- eynier concludes that the storage capacity of ıent is 3,750 kilogrammetres. This experiment ited to prove the alleged *enormous* superiority of the Faure element over the Planté. But we must remember that the Faure element is quite new and may admit of improvement, whilst that of Planté has had a career of 20 years.

THE advisability of lighting the streets of Dundee by the electric light was considered at a recent meeting of the Police Commissioners. The opinion of the meeting seemed to be that the results of the experiments being made in some of the larger towns should be awaited before steps were taken for the introduction of the light into Dundee.

THE Dundee Gas Commissioners have also appointed a Committee to consider and report on the electric light. It was stated at their recent meeting that several large consumers in the town were fitting up their premises for the electric light, and that if it were found satisfactory its development would affect the gas revenue.

THE Portobello Town Council has decided that, in view of the progress being made in the use of the electric light, it would be unwise at present to adopt the Burgh Gas Supply (Scotland) Act, 1876.

So successful has been the trial of the electric light in Greenock that its permanent adoption for lighting the quays, docks and harbours may be taken as settled.

ANTECEDENTS OF THE BELL TELEPHONE.—Mr. G. M. Hopkins concludes a lengthy illustrated article on this subject in the *Scientific American*, in which he refers to the recent decision of the U.S. Circuit Court at Boston, as to the Bell Telephone patent, thus "From what has been said it will be seen that the system of telephonic communication as used to-day is more Reis's than Bell's."

ELECTRIC LIGHT AT THE GREAT NORTHERN RAILWAY STATION, KING'S CROSS.—We received an invitation to view the lighting of this station on Thursday night last, but regret we were unable on that occasion to attend. The success which follows Mr. Crompton's installations of electric light is so well known that the omission of a personal visit becomes of less consequence in this case than usual, but we hope in our next issue to refer again to the subject, and to deal then more fully with detail than we can at present give space to do. The motive power is obtained off a short length of counter-shafting by a semi-portable engine by Messrs. Marshall & Co., of Gainsborough, the nominal horse-power being 12, but the engine is capable of working up to 35 horse-power. A second engine, for safety, will soon be added of the same type as that now used. Burgin machines in two groups, one of 2 machines, and one of 3 machines, are the generators, the field-magnets of each group being excited by two small dynamo-machines. The exciting current is said to be about 12 webers, and the effective current through the inside lamps about 17 webers, and that through the outside lamps about 24 webers. The lamps inside the station are 12 in number, 6 above the arrival platform and 6 above the departure platform, whilst outside the station the lighting is effected by the two more powerful lamps placed on a separate circuit. Thus there are 14 lamps, 3 on each of four separate circuits, and 2 lamps (outside) on a single circuit. When all the lights are in full work it is found that about 29 horse-power indicated is required, of which the engine and gearing absorb about 3½ horse-power each, of the exterior lamps about 3 horse-power and each of the interior lamps about 1½ horse-power. The engine shed is lit up by Swan lamps, requiring about 1½ horse-

power. An Addyman's clutch, manufactured by Messrs. Bagshaw, of Batley, will be used to put either engine into gear with the shafting instantaneously, in case of accidents.

ELECTRIC LIGHT AT EARNOCK COLLIERY.—Mr. John Watson, the proprietor of the above colliery, having determined on lighting it by electricity, a trial with the Swan incandescent lamp was made on the afternoon of the 9th instant. Since April last, Messrs. D. and E. Graham, of Glasgow, have been engaged fitting up the said lamps, which are somewhat modified in form to adapt them for safe use in mines. The Swan lamp, which is well known to our readers, is inclosed in an outer lantern consisting of a strong glass globe, air-tight and protected with steel guards. Each lamp was also connected with two different forms of Graham's patent safety air-tight contacts and switches for cutting off and letting on the current, the effect of which, it is believed, would be to render the lamps quite safe, even in the presence of explosive gas. The motive power used is a steam-engine, also used for driving a saw-bench, the dynamo-machine an A Gramme, situated at a distance of 260 yards from the pit-head. The conductors used are as follows:—*Dynamo to pit-head:* bare copper rope ⅜ in. diameter carried on poles and very effectually insulated at supports by a combination of porcelain cups and vulcanised india-rubber.—*Down shaft:* cable of 19 No. 22 B. W. G. copper wire insulated with gutta-percha taped and tarred, and inclosed in a galvanised iron ½ in. tube.—*Underground:* same conductor as down shaft, carried along workings partly on wooden uprights and partly beneath surface.—*Lamp leads:* No. 14, 16, 18 or 22 copper wire according to length.—*Number of lamps* at present working: 16 fixed and 6 portable, spread over about two miles (reckoning the return circuit) of wire.—*The fixed lamps* are suspended from roofs of workings, and are inclosed, as before-mentioned, in strong glass globes, and fitted with convex reflectors of silvered copper, whilst the *portable lamps* are attached to long flexible cables for use at the facings, and can be hung or deposited in any position. They are inclosed in very strong glass lanterns which are again protected by the stout wire guards. Although there is at present little or no gas in Earnock Colliery, all lamps, switches and contact-makers are constructed as for a fiery mine, being made quite air-tight, so as to render impossible the communication of a spark to the atmosphere of the mine. On the day of opening, blasting with gunpowder took place without affecting the lamps in the slightest degree. Messrs. Graham and their engineer, Mr. Alfred R. Bennett, M.S.T.E. and E., are to be congratulated on their success, as also is Mr. Watson on his spirited policy in inaugurating the new and improved illumination in his underground property. It may be mentioned that after an inspection of the light by the latter gentleman and some invited guests, Mr. Annan, of Glasgow, took photographs in three groups of the whole party assembled by the sole aid of the light afforded. On the return of the party to the surface an adjournment was made to the workshops. Mr. A. Jamieson, principal of the College of Science and Arts, Glasgow, who represented Mr. Swan on the occasion, gave to his practical audience a description of the construction and application of the Swan lamp. In connection with this an interesting incident transpired. Mr. Jamieson in answer to a colliery manager admitted that if the incandescent lamp as shown were broken in an explosive gas, an explosion would assuredly follow. An experiment was immediately arranged to determine the truth of this. An explosive mixture was prepared, and on the glass of the lamp being broken the explosion of course took place precisely as predicted.

New Patents—1881.

3254. "Improvements in cables or conductors for telegraphic, telephonic or similar purposes, which invention comprises an improved method of and apparatus for covering or coating wire with insulating material." H. H. LAKE. (Communicated by David Brooks.) Dated July 26.

3283. "Electric generators." S. PITT. (Communicated by S. J. M. Bear.) Dated July 26.

3274. "Improvements in lamp casings or holders for containing and protecting electric lights and in apparatus to be used in connection therewith, the said apparatus being in part applicable for other purposes." D. GRAHAM. Dated July 26.

3293. "Improvements in apparatus for igniting gas for illuminating by means of electricity, and in batteries connected therewith." A. J. HALLAM and J. WALSH. Dated July 27.

3294. "An electrical musical instrument called a 'Pianista.'" W. F. SCHMOELE and A. MOLS. Dated July 27.

3305. "Electric lights." Sir C. T. BRIGHT. Dated July 28.

3346. "Improvements in electrical signalling apparatus and in circuit connections adapted to fire alarms, messenger calls and telephones." J. U. MACKENZIE. Dated August 2.

3349. "Electric lamps." A. W. REDDIE. (Communicated by D. A. Chertemps.) Dated August 2.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1880.

5008. "Electro-magnetic induction machines." H. WILDE. Dated Dec. 1. 2d. Relates to a method of constructing electro-magnetic induction machines with multiple armatures for producing electricity, by which their power and efficiency are greatly increased. In this improvement the metal wheels or discs in which the armatures are mounted are slit in a radial direction towards the centre of each iron armature. The armatures are also slit in a radial direction towards their centres, and are fixed in the wheels in such a position that the slits in the wheels and the slits in the armatures coincide or extend into each other. The ends of the electro-magnets are terminated by pole pieces of iron, while the iron armatures which revolve between them are without such pole pieces. The polar terminations of the magnets are of such a diameter as to overlap the armatures, so that the magnetic circuit is never broken. The pole pieces at the ends of the magnets are slit radially towards the centres of the magnet cores. The sides of the discs in which the armatures are mounted are perforated near their centres for the purpose of admitting a free circulation of air between the coils of the armatures. (*Void by reason of the Patentee having neglected to file a Specification in pursuance of the conditions of the Letters Patent.*)

5268. "Transmitting drawings, characters, and writing by electricity," &c. A. W. L. REDDIE. (A communication from abroad by Jacques André, of Paris.) Dated Dec. 15. 6d. This invention relates to an improved system of electro-autographic transmission.

The main feature of the invention consists of a band of mixed tissue or web of any convenient length or breadth, formed by the grouping of a variable number of metallic conducting wires or threads, which are insulated electrically the one from the other by means of a weft of textile material, the warp threads being formed by the metallic conducting wires themselves. The reproduction of a tracing is effected by making this web pass under one end of a brush connected to a battery at the transmitting station at the same time that a receiving surface formed of slips of paper, or of a continuous band of paper or woven stuff, is caused to pass under the correspondingly formed brush at the receiving station. The receiving paper or fabric is covered with some substance which is decomposed or chemically changed by the electric current, so that by the action of electricity the original design will be exactly reproduced.

5387. "Micro-transmitters." William Johnson. Dated Dec. 22. 6d. Relates to improvements in micro-transmitters, and it consists in a novel arrangement of the well-known principle of the microphone of Professor Hughes, and also in a combination of such novel arrangement of a resistance coil or coils, shunt or shunts, all of which are embraced in an electric circuit, the object of the improvements being to render articulate speech and other similar sounds loud, clear, and distinct in the receiving telephone, which is attached to the line wire in the usual way. In carrying out the invention a microphone, consisting of two carbon pencils, is suitably supported on a diaphragm of wood, horn, mica, or other suitable material, and between the ends of the carbon pencils bobbins of insulated wire are connected in such a manner as to cause them to resist the passage of an electrical impulse, or to act as a means of shunting such an electrical impulse. The

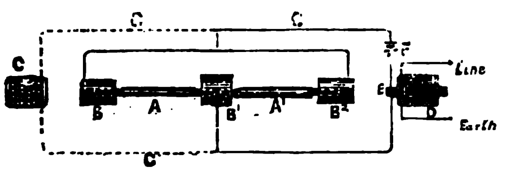


figure represents a micro-transmitter of the improved construction. A and A' are pencils of carbon loosely supported in blocks of the same material, B, B', and B²; these blocks are secured to a diaphragm by preference of pinewood, and which is fastened to a suitable sounding-box. C is a shunt or branch circuit of proper resistance; D is an induction coil, the secondary coil of which is placed in the line circuit in the usual way. The positive current from the battery, F, passes through the primary, E, of the induction coil, D, to the central block, B'; it then either divides between the arms or takes the arm or pencil which offers the least resistance, being either A or A', and completes the circuit through the connection, G. If contact is momentarily interrupted in the arm, A, the arm, A', allows the circuit to be completed, and *vice versa*, and thus the possibility of a breakage in the primary circuit is to a great extent obviated; but in order to render the manifestation in the receiving telephone of such a breakage impossible, the branch circuit, C, is introduced, so that if breakage or other disturbance should occur in the microphone by which the circuit cannot be completed through the microphone, the circuit is then made through the shunt, C, which is of low resistance, thus effectually bridging over the fault and allowing the induced extra current to pass without the injury to the contact points, and thus speech is much more faithfully reproduced and with increased clearness and distinctness of articulation, whilst the common harsh and grating noise so often heard is prevented.

5482. "Telephonic apparatus." C. J. Wollaston. Dated Dec. 30. 6d. Has for its object so combining telephones, microphones, or other form of transmitter, electric batteries, switches, and signal bells, as to make the entire apparatus portable and convenient for use in military and naval operations, the exploration of coal pits and mines, in torpedo or submarine mining, and for other purposes where the telephones are used out of doors or exposed in such a manner as to render them liable to be affected as to their practical efficiency by local disturbing influences.

City Notes.

Old Broad Street, August 11th, 1881.

Globe Telegraph and Trust Company. — The eighth ordinary meeting of this company was held on July 29th at Cannon Street Hotel, Mr. John Pender, M.P., being in the chair. The net revenue for the year was £171,379, of which sum £122,066 had been distributed in interim dividends. A final distribution of 3s. per share was declared on both Preference and Ordinary shares, making a dividend of 6 per cent. on the Preference and 4½ per cent. on the Ordinary shares The Chairman, in proposing the adoption of the report, stated that, notwithstanding a reduction from 5 per cent., paid in 1880, to 3½ per cent. paid this year by the Anglo-American, they were able to pay the usual rate of dividend by the profits upon exchanges with the Brazilian, Eastern, Eastern Extension, and other companies. They had acquired 3,000 Eastern shares in exchange for 1,000 Telegraph Construction and Maintenance shares. An improvement of ½ to ¾ had taken place in Easterns since the acquisition. The number of shareholders on the register had increased from 600 to 6,000, and the increase had been most considerable during recent years. Of the 66,000 miles of cable which had been laid, the company held shares in companies owning 47,563 miles, or more than two-thirds of the whole. In reference to the American cable, he did not anticipate any injury to the interests of the company. He was only astonished that the Americans had not before this had a cable of their own. He showed that the charge of being a monopoly had no foundation. If the directors had acted in the spirit of monopoly they might have paid much larger dividends, but they had preferred to make reductions in favour of the public. Sir Daniel Gooch seconded the motion, which, after some discussion, was carried without a dissentient.

The Submarine Telegraph Company.—The half-yearly ordinary general meeting of the proprietors of this company was held August 3rd at the City Terminus Hotel, under the presidency of Sir James Carmichael, Bart., the chairman of the company. The directors' report to the 30th June, 1881, showed a net balance of £38,077, which enabled them to add 10 per cent. to the gross receipts to the reserve fund, and to recommend a dividend at the rate of 19 per cent. per annum. The Chairman, in moving the adoption of the report and statement of accounts, alluded to the new offices in Throgmorton Avenue, and said that the total cost of the new building would be something like £200 a year less than they were paying before to the Post Office, besides which the company had acquired a valuable and improving property, which he considered as a valuable investment for their reserve fund. Under their present charter they had not power to purchase land or property to the amount of more than £1,000, and as their present building exceeded that sum, they were con-

sequently beyond the powers of their charter. They had already asked the shareholders for a supplemental charter to fix the additional outlay, but the solicitor advised them that the legal expenses would be considerable, and suggested that they should register the company under the Limited Stock Companies Act, 1862, under which Act they would have power to purchase land or property to any amount. The board had, he said, endeavoured to prepare a scheme for providing a fund for the benefit of the staff of the company in accordance with the recently expressed wishes of the proprietors, but they found some difficulty in dealing with this question, as the plan of endowment assurance generally adopted by other telegraph companies did not appear altogether applicable to the position of a large number of the company's servants. The board had been advised that under clause 87 of the deed of settlement of this company, they had full power to make such compensation as they might think fit to any of the clerks, agents, and servants of the company, without any special resolution of the proprietors. The board had resolved to treat every individual case which might come before them with great care and liberality. They had laid down about eight miles of new cable, and thus the cost of repairs to cables in the past six months hed been larger than usual. The motion for the adoption of the report was seconded by the Hon. Ashley Ponsonby, and, after a brief discussion, unanimously agreed to. On the motion of the Chairman, seconded by Sir Thomas Dakin, the following resolution was also carried:— "That in lieu of applying for a supplemental charter, as authorised by the resolution passed at the half-yearly meeting of the proprietors, held in February, 1879, the directors be authorised to register the company under the Companies Acts 1862 to 1880, as a company limited by shares, for the purpose of giving the company further powers to purchase or take on lease land to erect suitable premises for carrying on the business of the company." The usual routine business was run through, and the dividend having been declared, the usual compliment to the Chairman and staff terminated the meeting.

MEDITERRANEAN EXTENSION TELEGRAPH COMPANY, LIMITED. — The forty-eighth ordinary half-yearly general meeting of the shareholders of this company was held on August 5th, at the Cannon Street Hotel, Sir James Carmichael, Bart., the Chairman of the company, presiding. The directors' report of the past six months ending the 30th June last showed that there had been an increase in the traffic of the previous half-year of £631, and the amount to be claimed under the guarantee of Her Majesty's Government would be proportionately diminished. The directors proposed payment of the usual dividend at the rate of 8 per cent. per annum, less income-tax, on the preference stock of the company, and at the rate of 3 per cent. per annum on its ordinary stock, leaving £462 to be carried to the reserve fund. The Chairman in moving the adoption of the report and statement of accounts, suggested that it would be better to leave the question of the purchase of the property by another company until after the report had been agreed to. Turning briefly to the accounts, he said they would see that the amount to the credit and reserve fund stood at £11,401; amounts owing on account of messages transmitted over other lines to 30th June last, £10,311; sundry amounts owing by the company, £132; balance of revenue account, less income-tax, £3,510. On the other side of the account there was funded property (amount invested in New Three Per Cents.), £11,394; *amount due from* other lines on account of messages transmitted by this company to the 30th June last, £8,499; sundry amounts due to the company, £125; cash in hand, £521; cash at bankers, £130; short bills in hand, £1,859; amount due from Her Majesty's Government, £2,826. He remarked upon the condition of the company's affairs, and said the company's cables were in good order, and the cost of maintenance had been trifling. He then formally moved the adoption of the report, which was seconded by the Hon. Ashley Ponsonby, and without discussion, agreed to. The Chairman then referred to the question of the purchase by another telegraph company of the property and interest of this company. After explaining the terms under which it was proposed that this should be effected, he said that before deciding upon anything definite, the board would of course summon the shareholders together and lay the whole matter before them. On the motion of Dr. Dearle, seconded by Mr. Hibbert, it was decided to leave the question entirely in the hands of the directors, they in the meantime to put themselves in communication with the Treasury and endeavour to negotiate satisfactory terms. This was, after a good deal of discussion, agreed to. The Chairman having declared the dividends on the ordinary and preference stock of the company, the retiring directors and auditors were then duly re-elected, and the usual compliments to the Chairman and board terminated the meeting.

ANGLO-AMERICAN TELEGRAPH COMPANY, LIMITED. —The half-yearly general meeting of this company was held on August 5th at the City Terminus Hotel, under the presidency of Viscount Monck. The report stated that the total receipts from the 1st of January to the 30th June last, including a balance of £66, brought over from the last account, amounted to £300,431. The traffic receipts showed an increase as compared wit the corresponding period of last year of £31,455. The total expenses of the half-year, including income-tax and repair of cables, &c., amounted to £61,885. One quarterly interim dividend of 2 per cent. on the preferred stock, and of 1 per cent. on the ordinary stock, free of income-tax, was paid on the 1st May, absorbing £70,000, and a second quarterly interim dividend at the same rates, free of income-tax, would be paid on the 2nd August, leaving a balance of £23,545 to be carried forward. The Chairman, in moving the adoption of the report, remarked that the state of things which he had to bring before them, if not particularly exhilarating, did not, in his opinion, afford any reason for despondency. The commercial depression, of which they had heard so much for years past, though considerably relieved, had not entirely passed away. He then referred to the circumstances which led to the postponement of the payment of the dividend on the last occasion, and reminded them that it had since been paid. Their cables were in good working order, and carrying the traffic as well as could be expected. He afterwards alluded to the visit of their solicitor (Mr. Birt) to New York, to watch over the company's interests in the difficulties mentioned in the report, consequent on the combination of the land telegraph companies in the United States; and referring to the charge of monopoly which was made against the Atlantic Telegraph Companies, his lordship spoke of the reductions which had been made in their tariffs, and the excellent manner in which their work was done. The reductions had put more money into the pocket of the company, and they must only hope that the reduction to 1s. a word would have the same effect, and that notwithstanding the competition of the new cable, there would be room for them all. Sir James Anderson seconded the motion, and it was unanimously adopted.

THE WEST COAST OF AMERICA TELEGRAPH COMPANY, LIMITED.—The report of the directors presented to the shareholders for the year ending December 31st, 1880, shows the gross revenue to be £17,398 4s. 2d., and the expenditure £31,815 1s. 6d., leaving a balance of £14,416 17s. 4d. to the debit of revenue account. The revenue account though far from satisfactory, is as favourable as could reasonably be looked for under all the circumstances. The expenses of the repairing steamer *Retriever* are rather large, but the next accounts will show a considerable saving in these expenses, whilst the trading earnings of the steamer will, it is expected, show a material increase. At the time of issuing the last report, three sections of the company's cables were cut and out of use, and it is only since the cessation of the war that all the sections have been repaired and the entire system put into complete and perfect working order. All the company's cables are now in active operation, and ready to take advantage of any increase of business that may be brought about by the revival of trade, and the re-establishment of peace on the Coast. Since the 1st of May, 1881, the receipts of the company have shown a steady increase, and have amounted, for the three half-months ending 15th instant to £5,000. It will be satisfactory to the shareholders to learn that during the repairing operations the manager had many opportunities of inspecting the general condition of the cables, and that he reports they are in as good a condition as when they left the works of the manufacturers.

DIRECT UNITED STATES CABLE COMPANY, LIMITED.—The eighth ordinary general meeting of this company was held on July 28th, at the City Terminus Hotel, under the presidency of Mr. Pender, M.P. The Chairman, in moving the adoption of the report, and the declaration of a final dividend of 5s. per share, making, with interim dividends, a total dividend of 5 per cent. for the year, stated that the revenue for the half-year to the 30th of June last, after deducting out payments, amounted to £93,581, and the working and other expenses, including interest on debentures and income tax, absorbed £26,871, leaving a balance of £66,710 as the net profit of the half-year. They had carried £32,292 to the reserve fund, and they carried forward £7,179. The expenses had been maintained at their present figure, in spite of a very large increase in their business. He congratulated them on this fact, on the repairs having cost only £2,496 which had been charged to the reserve fund, and on the increase of that fund to £235,000. He denied that the submarine telegraph system had been a monoply, and alluded to constant reductions having been made in the tariff. This company and the Anglo-American Company were now about to reduce the charges to 1s. a word, a matter which he said had been long under consideration of both boards. As to the effect of the Americans having a submarine telegraph system of their own, he believed, seeing the enormous growth of the business, that there would be room for all of them. The resolution was seconded and carried unanimously.

THE CONSOLIDATED TELEPHONE CONSTRUCTION COMPANY.—The statutory general meeting of the above company was held on the afternoon of the 8th instant at the City Terminus Hotel. Sir Julius Vogel, K.C.M.G., the Chairman, presided, and stated that as the present was the statutory meeting of the company, there was no business to transact; but it had occurred to the directors that he might take that opportunity making a general statement as to the position and of prospects of the company. They had over 700 shareholders. They had already established a factory, and in course of a week or two they would be able to turn out between 100 and 200 instruments a week. They had an agreement with the United Telephone Company, by which that company had bound themselves to take all the instruments they required from this company; and he reminded them that that company, after a great deal of litigation, had practically secured a monopoly of the telephone in the United Kingdom. Outside that arrangement, this company had to fulfil orders for a very large number of instruments which they took over when they purchased the rights of Mr. Gower. This company had also the sole right of making and selling telephones for export in this country, and they anticipated a very large export business. They had acquired valuable patents for abroad. In his opinion the telephone in this country and in Europe, and indeed everywhere except in the United States, was in the very earliest infancy of its development. Altogether he though they had excellent prospects before them in this country, apart from the special rights to which he had referred. A vote of thanks to the Chairman terminated the proceedings.

THE UNITED TELEPHONE COMPANY.—At the first annual meeting, held on August 9th, at the Cannon Street Hotel, Mr. James Brand in the chair, the report and accounts having been taken as read, the Chairman, in moving their adoption, said he thought the shareholders would agree with him that the balance-sheet was, on the whole, not unsatisfactory. He was glad to say that they met under more pleasant circumstances than they did when he last addressed them. At that time they were surrounded by dangers on every side. The directors were accused of every imaginable fault, and people predicted the utter collapse of the undertaking; but now there was manifest vigour, and, considering the difficulties with which they had had to contend, and how greatly they had been hampered by the uncertainty as to their position in relation to the Government, he thought the development attained was very remarkable. All this time the directors had been plodding on, preparing the cables and other things which were necessary to enable them to meet the increased requirements of the public, which were now, he was happy to say, pouring in upon them. He had before him some remarkable statistics compiled by the auditors, showing the gradual increase in the number of subscribers, and in the use of the instruments, and the decreased expense at which the results were achieved. In the months of May, June, and July, 1880, the company having begun with only forty subscribers, the average number of calls was 2·2 per day, while the total number of subscribers for the three months was 609. In August, September, and October, the average number of calls was 3·1, and the number of subscribers rose to 707. In November, December, and January, there were 415 calls and 820 subscribers. In July of this year there were six calls on the average per day. There were now 1,052 subscribers, and there were many orders on hand. To this he might add that the expenditure had fallen from its highest point of £350 to £201 per week. These figures spoke for themselves, and were a complete answer to those who had regarded them as enthusiasts amusing themselves with a toy. Some of the hotels, and a great many of the principal tradesmen, were now availing themselves of the services of the company, and what was most needed was for the shareholders to assist in the development of their own property. Of 650 shareholders, so far as the London district was concerned, only 25 were at present subscribers. The company would receive £50,000 for the sale of half their interest in the district of the Lancashire and Cheshire Telephone Company, keeping the other half, which he

considered to be worth £50,000 more. In concluding, he remarked that they were working in a friendly spirit with the Consolidated Construction Company.—Mr. J. S. Forbes having seconded the motion, a discussion ensued, in the course of which Mr. Galsworthy expressed his satisfaction that solicitors would be allowed to charge telephone messages sent by them professionally as if they were letters. Ultimately the report, including the recommendation of a payment of 10s. per share as bonus out of the £50,000 to be received from the Lancashire and Cheshire Telephone Company, was adopted. A resolution was afterwards agreed to approving an agreement with Mr. C. H. Reed, for granting an exclusive licence for the use of the company's patents in certain districts to a company intended to be formed under the name of "The Northern District Telephone Company," the proceedings terminating with a vote of thanks to the chairman.

A POSTAL TELEGRAPH COMPANY (of America) which promises to be a rival of the Western Union, says a correspondent of the *Daily News*, has been organised. Mr. James R. Keene is the president. Among the stockholders are the Californian Bonanza millionaires. The company have acquired several novel patents, including W. A. Leggo's automatic machines, said to send two thousand words a minute; the Leggo facsimile machine, which sends autographic telegrams (those shown are like photographs); the Gray harmonic multiple system, which is claimed to surpass even the quadruplex. The Way duplex system has also been acquired. Peculiar interest attaches to this invention, owing to its alleged applicability to cables. Relays are not used even on land. The capital of the company is twenty-one million dollars. The subscriptions announced amount to ten millions. They have already spent on plant and patents over two millions. It is estimated that the total cost and equipment sufficient for any amount of business will not exceed fifteen millions.

MR. JAMES A. SCRYMSER, president of the Central and South American Telegraph Company, is said to have arrived in this country to close a contract for some three thousand miles of telegraph cable, to be laid along the Pacific coast of Central and South America from Mexico to Peru, connecting at Vera Cruz with the Mexican Telegraph Company's lines, and at Callao with the West Coast Telegraph to Valparaiso and the Argentine Republic.—*Railway News.*

GLOBE TELEGRAPH AND TRUST COMPANY.—Mr. W. Griffiths, barrister-at-law, has been elected auditor to this company in place of Mr. Newmarch, who has retired.

THE Eastern Telegraph Company notifies the restoration of telegraphic cable communication with India, China, Manilla, Java, Australia, and New Zealand, *via* Bombay.

THE board of the Oriental Telephone Company, Limited, have received the following message from Alexandria, Egypt, dated 9th inst.:—"Telephone Exchange opened yesterday. Subscribers now talking. Working satisfactorily."

The following are the final quotations of stocks and shares:— Anglo-American, Limited, 51½-52; Ditto, Preferred, 82½-83½; Ditto, Deferred, 24¾-25¼; *Brazilian Submarine, Limited*, 10⅛-10⅝; Brush Light, ——; *Electric Light*, ⅛-⅜; Consolidated Telephone Construction, 1-1¼ A; Cuba, Limited, 9½-10; Cuba, Limited, 10 per cent. Preference, 16½-17; Direct Spanish, Limited, 4¾-5¼; Direct Spanish, 10 per cent. Preference, 13½-14½; Direct United States Cable, Limited, 1877, 10⅞-11⅛; Debentures, 1884, 102-104; Eastern Limited, 10⅜-10⅝; Eastern 6 per cent. Preference, 12⅝-13⅛; Eastern, 6 per cent. Debentures, repayable October, 1883, 102-104; Eastern 5 per cent. Debentures, repayable August, 1887, 102-105; Eastern, 5 per cent., repayable Aug., 1899, 105-108; Eastern Extension, Australasian and China, Limited, 11-11½; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 107-110; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 103-106; Ditto, registered, repayable 1900, 103-106; Ditto, 5 per cent. Debenture, 1890, 103-105; Eastern and South African, Limited, 5 per cent. Mortgage Debentures, redeemable 1900, 103-106; Ditto, ditto, to bearer, 103-106; German Union Telegraph and Trust, 10¼-10¾; Globe Telegraph and Trust, Limited, 6½-6¾; Globe, 6 per cent. Preference, 12¾-13; Great Northern, 13-13½; 5 per cent. Debentures, 103-106; India Rubber Company, 23-24; Ditto, 6 per cent. Debenture, 104-108; Indo-European, Limited, 28-29; London Platino-Brazilian, Limited, 5⅝-6⅛; Mediterranean Extension, Limited, 2¾-3¼; Mediterranean Extension, 8 per cent. Preference, 9¼-9¾; Oriental Telephone, ¼——; Reuter's Limited, 12-13; Submarine, 290-300; Submarine Scrip, 2¾-3; Submarine Cables Trust, 100-104; United Telephone, 9⅜-9⅞; West Coast of America, Limited, 4½-5½; West India and Panama, Limited, 1¾-2; Ditto, 6 per cent. First Preference, 7-7½; Ditto, ditto, Second Preference, 6-6½; Western and Brazilian, Limited, 8-8½; Ditto, 6 per cent. Debentures "A," 110-115; Ditto, ditto, ditto, "B," 101-105; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 125-130; Ditto, 6 per cent. Sterling Bonds, 106-110; Telegraph Construction and Maintenance, Limited, 29-29½; Ditto, 6 per cent. Bonds, 104-108; Ditto, Second Bonus Trust Certificates, 3⅛-4⅛.

TRAFFIC RECEIPTS.

NAME OF COMPANY.	JUNE.	JULY.	REMARKS.
	£	£	
Anglo-American... 1881	48,240	46,410	After July the publication of the receipts of this company will be suspended.
1880	19,500	19,500	
Brazilian S'marine 1881	12,272	11,755	Calendar month
1880	10,524	10,509	
Cie. Française ... 1881	...	...	Not published
1880	..	..	
Cuba Submarine... 1881	2,757	2,300	
1880	3,147	2,915	
Direct Spanish ... 1881	1,456	1,448	
1880	1,277	1,433	
Direct U. States... 1881	16,080	15,470	
1880	6,520	6,500	
Eastern 1881	40,074	38,171	
1880	42,532	43,352	
Eastern Extension 1881	29,339	31,751	
1880	20,100	32,194	
Great Northern ... 1881	21,760	22,400	
1880	22,590	25,500	
Indo-European ... 1881	...	...	Not published.
1880	..	..	
Submarine 1881	...	...	Publication [illegible] porarily [illegible] pended.
1880	..	..	
W. Coast America 1881	...	...	
1880	..	..	
West. & Brazilian 1881	3,943	9,396	Five weeks in each case.
1880	3,725	8,811	
West India 1881	4,743	4,116	
1880	3,907	3,712	

THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. IX.—No. 206.

THE PARIS ELECTRICAL EXHIBITION.

IT has been said that the Paris Electrical Exhibition lacks interest on the score of novelty, for at the present day, when intercourse and intercommunication between the various countries which form the civilised portion of the globe is so comparatively easy, novelties cease to be novelties within almost a few days after their publication in the country of their origin. This is true to a very great extent, but at the same time it is not universally the case; several European countries, about which but comparatively little is heard, have practically been considered to be quite in the rear of the progressive march of electrical science. The Electrical Exhibition has, however, quite dispelled this illusion; take, for instance, Norway and Sweden: in both these countries electrical and telegraphic exhibits are shown which will yield the palm to no other country in respect of ingenuity or mechanical design. In the Swedish Department, one of the most prominent exhibits, and perhaps the most ingenious exhibit in the whole exhibition, is the "Theorell Printing Meteorograph." Meteorological observations are shown by this instrument on tables printed on a slip of paper. Of six tabular columns, the first gives the hours; the second, the velocity of the wind; the third, the direction of the same; the fourth, the temperature; the fifth, the degree of humidity, according to August's method, by the wet and dry bulb thermometers; and the sixth, the atmospheric pressure, which is given in millimetres. The degrees of the thermometer employed are those of the centigrade scale, and negative degrees are expressed by their complements of 100. The direction of the wind is indicated by figures from 1 to 32. The numbers expressing the velocity of the wind signify metres in a second. The registration takes place by means of electrical currents, which are closed in the barometer and both the thermometers by contact between the mercury and steel wires that descend into their tubes, and at the weather-cock and anemometer by contact between a metal knob, which is put into

FIG. 1.

motion by the current, and a wheel which is in direct mechanical combination with each of these instruments. The steel wires in the barometer and in both the thermometers are connected, each by its respective system of brass wheels, with numerical types, engraved on the edges in such a manner that the rotation of the wheels causes an upward or downward motion of the steel wires, so that the point of the scale on which the lower extremity of the wire is situated is necessarily that indicated by the number appearing at the same moment uppermost on the corresponding wheels. The two other

brass wheels with engraved figures are likewise combined, by means of electric currents, in such a manner with the above-named metal knobs on the weather-cock and the anemometer that the figure which is uppermost on the periphery of the wheels, each observation sets the five systems successively in motion, until the corresponding wires have reached the mercury in the barometer and the two thermometers, and caused a contact between the above-named metal knob in the weather-cock and the

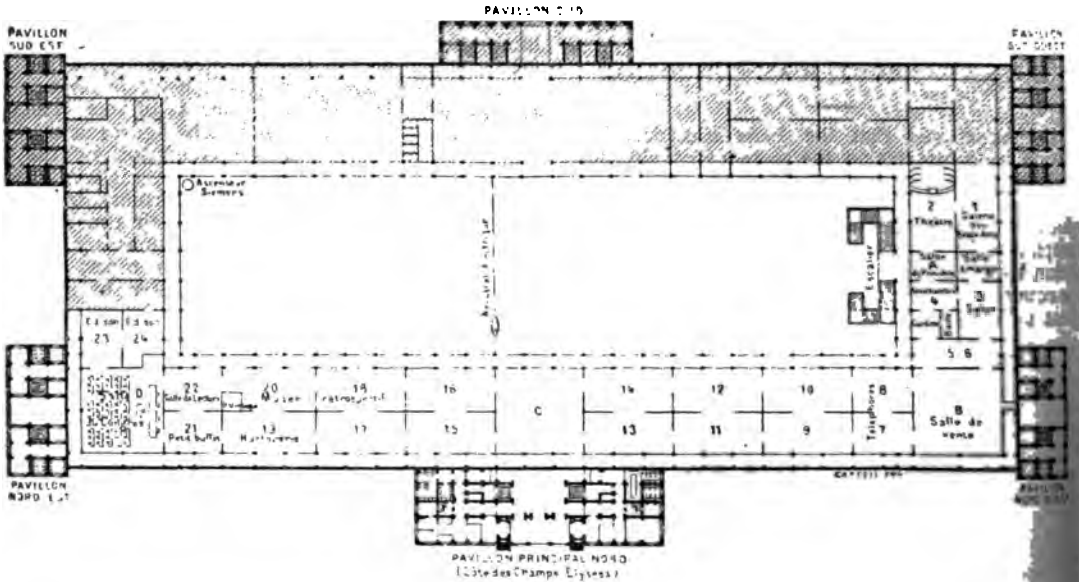


FIG. 2.

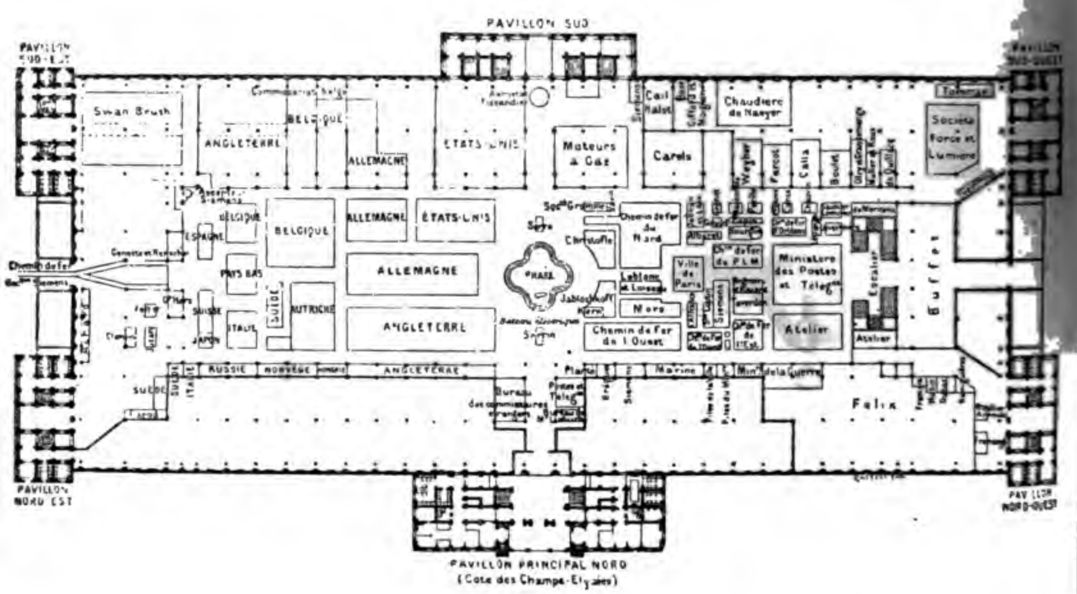


FIG. 3.

at the moment it is about to be registered, indicates the direction of the wind at the same moment, and its mean force during the preceding quarter of an hour. The wheels containing the figures are governed by an electro-magnetic motor, which for anemometer, and the wheels which are in a mechanical combination with each of these instruments. The numbers, therefore, that are uppermost on the numbered wheels are just those which indicate the height of the barometer and of the two

[...]eters, as well as the direction and velocity [...]nd. And, now, the same electro-magnetic [...]erates upon a printing apparatus, which, [...]ng deposited colour on the types, presses [...]e-mentioned slip of paper against them. [...]g done, the steel wires are drawn up again [...]otor, which stops as soon as a certain [...]from the mercury is attained, and all is [...]r the next observation. The interval [...]the observations is a quarter of an hour. [...]strument, it will be understood, has the [...]antage that it gives the observations in [...]rm that they may be immediately, and [...]further modification, used by the meteor[...]n his work. A large number of comparisons, [...]efully made, have shown that the observa[...]gistered with the aid of the method here [...]d have an accuracy equal to that usually [...]le by ocular observation. The zinc vessel, [...]the upper ends of the thermometers are [...], is so air-tight that it has been found pos[...]means of chloride of lime and caustic potash, [...]the inclosed air always free from damp and [...] acid, a precaution which, it will be easily [...]ood, is necessary in every climate where the [...]ture is liable to sink below the freezing [...]ut is still more so in order to protect both the quicksilver and the steel wires from oxydation, and thus preserve the galvanic contact. A meteorograph of this construction has now been used at Upsala Observatory for two years, and during that time it has made four observations every hour without causing any perceptible change in the surface, either of the mercury or the steel wires, that could in any way affect either the free efficiency of the instrument or its degree of accuracy, which, throughout the whole time, has been found to be as above stated. As the clock, which determines the time of the observations, does not require winding up—the instrument itself restoring the tension of the mainspring every quarter of an hour—it continues going as long as the impellent force, *i.e.*, the electric current, is maintained; and as the slip of paper applied lasts for fully three months, it is clear that that is the period for which the instrument may be left to itself. The work then requisite is little more than taking out, cutting, and sewing up, in order, the paper of observations, and replacing it by another slip. Thus it will be seen that this instrument requires but very little time and labour from the person who takes charge of it. The general form of the receiver of the apparatus is shown by fig. 1.

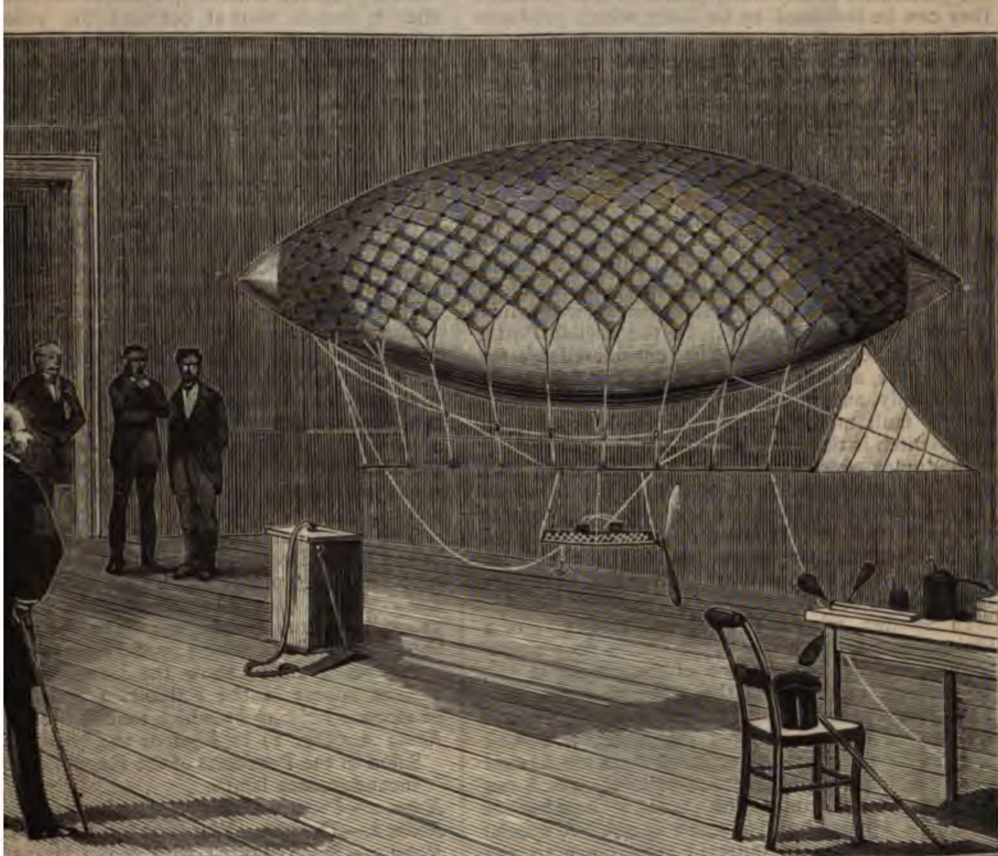


FIG. 4.

A printing meteorograph, differing from this only

so far that the latter has been improved and perfected in several details, has been constructed by the same mechanician, Mr. Sörensen, for the Imperial Central Establishment for Meteorology in Vienna, where it has been in daily use since September, 1874; and during that time it has given exact and true observations. A description of this meteorograph is inserted in "Zeitschrift der Osterreichischen Gesellschaft für Meteorologie, redigirt von C. Jelinek und J. Hann," Volume X., Nos. 16 and 17.

Finally, it is pointed out that the principle on which this instrument has been constructed may be adopted, with the same advantage, for observing the particulars of any other phenomenon, provided they can be indicated by an index which produces a galvanic contact.

Although the foregoing instrument is undoubtedly the most interesting exhibit in the Swedish Department, it is by no means the only object of interest. A very complete electric automatic railway signalling apparatus, and also a system of fire-alarms for small towns, of thoroughly practical design, are shown in working order.

The telegraphic apparatus, although not elaborate, is most excellent of its kind. The Morse printer is the instrument most employed. This is arranged either for duplex or single working, the changes from the one to the other system being made when required by means of plugs. In the British Postal Telegraph Service plugs are not considered safe for the purpose, as they are liable to be knocked loose accidentally, and, in the hands of an unskilled clerk, such a fault might cause considerable trouble; a hand-switch is therefore employed. In connection with duplex working, it may be mentioned that there is exhibited a form of duplex key in which the battery contact is made and the earth contact broken at the same moment. This key, designed by M. Nyström, was the first of the kind ever made, and the honour of the invention therefore belongs to Sweden.

In Sweden, where the telegraph service is of a limited extent, the whole of the staff is very highly trained, indeed, one or two of the employés are, we believe, members of the Swedish parliament. The apparatus for giving instruction in the various systems of testing is most ingenious, and well adapted for the purpose; artificial lines are formed by a combination of resistance-bobbins, which can be grouped in connection with a number of terminals arranged on a small board. A special resistance, similar in outward appearance to the other resistance-bobbins, is formed of two platinum plates immersed in a small tube filled with water, and is used to represent a fault. The various bobbins can be shifted about and connected together most readily by clip springs to the various terminals, so that every kind of combination required to represent one or more actual lines may be obtained; thus contact tests, earth tests, &c., can be made by learners in a most satisfactory manner. The arrangement of apparatus for actual testing at stations is very good, and enables every variety of test required to be made with the least trouble possible. In countries like Sweden, where lengths of line stretch for perhaps two or three hundred miles without an intermediate station, *accurate tests for localising* faults are highly necessary, and the arrangements referred to are certainly thoroughly well designed for the purpose.

Amongst the historical exhibits we observe a differential galvanometer designed by M. Edlund; to the latter gentleman belongs the credit of having been the inventor of the differential principle.

A most ingenious mechanical arrangement for the quadruplex telegraph system, devised by M. Wennman, preliminary director of the Telegraph School, Stockholm, is also shown. This arrangement enables the use of relays on short lines worked on the quadruplex system to be dispensed with. One of the Morse printers, which is caused to respond to strong currents, is provided with a polarised armature, which is normally set so that it stands neutral between the poles of an electro-magnet; a strong positive or negative current, however, causes it to be attracted either up or down, in either case lifting the inking-wheel of the Morse against the paper and causing it to print. If the current is suddenly reversed the armature flies from one side to the other, as in the ordinary compound quadruplex relay, but so quickly that the inking-wheel, which is geared to a small separate lever, has not time to drop and stop marking. A modification of the Gerritt-Smith compound relay, also invented by M. Wennman, is shown, in which the contacts are so arranged that the employment of an "uprighting sounder" is not required.

Amongst the other exhibits are batteries of the form designed by M. C. A. Nyström, a collection of tools for telegraph line construction; pole climbers, invented and constructed by M. G. Forssberg; telegraph wires, electrometers, magnetometers, and a complete military telegraph equipment. A modification of the Wheatstone automatic fast-speed instrument, designed by M. Carlander, is also shown.

The general arrangement of the various sections in the Paris Electrical Exhibition is shown by the accompanying plan, which we reproduce from *L'Eléctricien.* It will be seen that the whole of the ground-floor and the major part of the galleries of the building are occupied by the objects exhibited.

Figures 2 and 3 show the arrangement of the various rooms in the Exhibition and the system of electric lighting by which each is illuminated.

Room A (Fig. 2) in front of the great staircase. Salon of the President of the Republic. Reynier incandescence lamps.

Room 1.—Picture Gallery. Sun lamps.

Room 2.—Theatre. Werdermann lamps.

Room 3.—Salon lighted with Jamin lamps. Salon lighted with Werdermann lamps.

Room 4.—Vestibule, kitchen, bath-room, lighted by the Société Force et Lumière (Faure accumulators and incandescence lamps).

Rooms 5 and 6.—Thrown into one. Exhibition of Jamin lamps and Gramme alternating current machines as modified by M. Jamin.

Room B.—Entrance hall lighted by Jablochkoff candles. Exhibition of Jablochkoff candles, small apparatus, &c.

Rooms 7 and 8.—Fitted up with telephones connected to the auditorium of the Opera House. *Room* 7 lighted by the Société Force et Lumière. *Room* 8 lighted by the Brush Company.

Room 9.—Medical and telephonic apparatus, coils, &c. Lighted by the De Méritens system.

Room 10.—Exhibition of the Sautter and Lemonnier light. Apparatus for domestic purposes.
Room 11.—Jablochkoff light. Liébert's photographic studio.
Room 12.—Spanish Electric Light Company (Gramme lamps). Carbons and electric lamps.

and Alliance machines, Wilde candles). Telegraphic and domestic apparatus. Bells.
Room C.—United States Electric Light Company (Maxim system). Cables, telephones, and telegraphic apparatus.
Room 15.—Jaspar electric light system. Electric

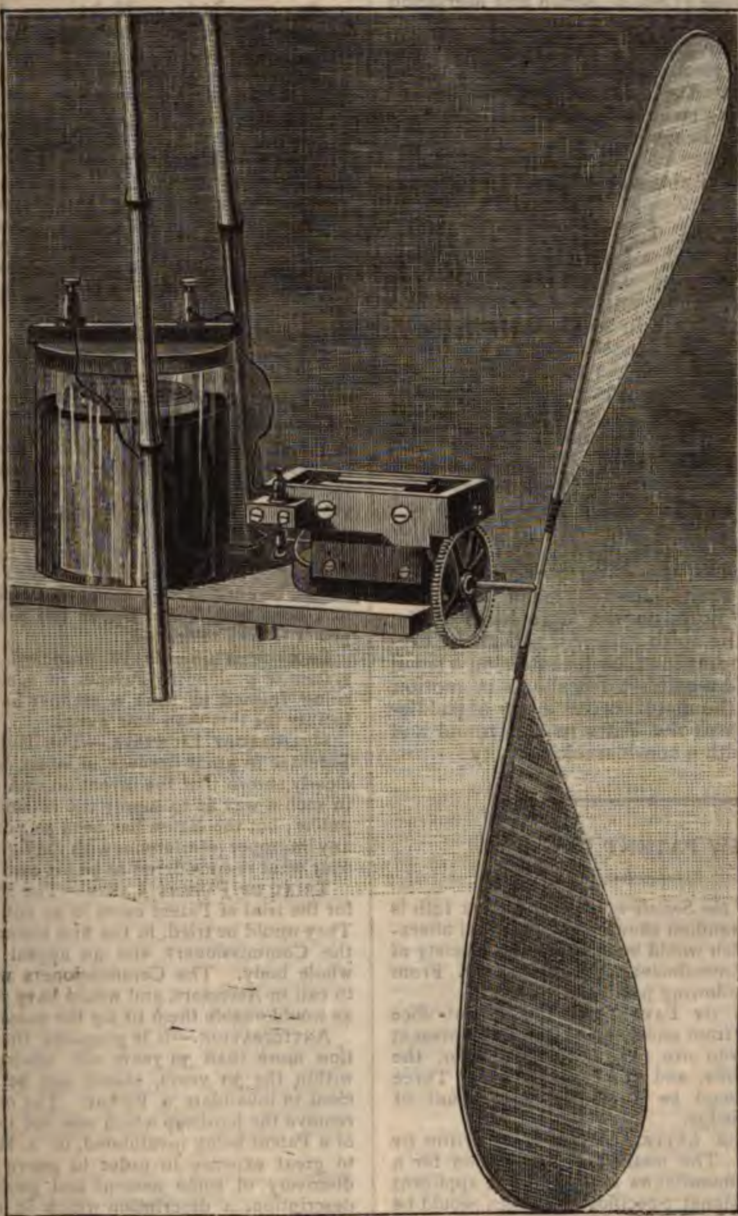


FIG. 5.

Room 13.—Siemens' electric light (differential lamps). Apparatus for electric measurement. Coils, electro-magnets, Geissler tubes, &c.
Room 14.—Paris Electric Light Company (Wilde

lamps, telegraphic apparatus, batteries, bells, lightning conductors.
Room 16.—Anatole Gérard's electric lamps. Apparatus of various kinds, wire, &c.

Room 17.—Syndicat de l'Electricité. Gramme lamps, electro-chemistry apparatus, batteries, electrotyping, &c.
Room 18.—Old apparatus. Mignon and Rouart's electric light.
Room 19.—Exhibition and lighting by the Société lyonnaise de constructions mécaniques et de lumière électrique (Lontin, Bertin and Mersanne systems). Electric clocks.
Room 20.—Old apparatus; Fyfe's electric lighting system; Daft's electric lighting.
Room 21.—Restaurant. Swan electric lighting.
Room 22.—Reading room. Journals and books on electricity, &c. Brush lamps.
Room D.—Conference hall. Swan lamps.
Rooms 23 and 24.—Exhibition and electric lighting, by Edison.

The model of the Tissandier balloon, which makes short aerial flights from the north gallery, and of which we give illustrations reproduced from *La Nature*, is driven by a small Trouvé motor (see TELEGRAPHIC JOURNAL, Oct. 1st, 1880), to which a large fan is attached, 40 centimetres in diameter. The motor weighs 220 grammes, and works for several minutes with a Planté element, also weighing 220 grammes. With a secondary couple weighing 1·300 kilogrammes, the duration of the motion is considerable. The motor bobbin under these conditions turns 6½ times per second; by turning, the fan gives to the balloon, in a still atmosphere, a velocity of one metre per second for about 40 minutes.

The application of the Trouvé motor to propulsion is also shown in the small skiff, *The Telephone*, which floats on the large basin in the central hall. In the north gallery, small model toy-boats, about 18 inches long, each containing a small Trouvé motor and a battery, are shown in motion in a small tank; the motor drives a pair of paddle-wheels, which causes the boats to run round and round the tank with a considerable velocity.

NEW PATENT LAW.

IN the *Journal of the Society of Arts* of August 12th is published a memorandum showing the principal alteration in the law which would be made by the Society of Arts' Bill for the Amendment of the Patent Law. From it we extract the following particulars:—

COMMISSIONERS OF PATENTS.—The Patent-office would be removed from under the charge of the present Commissioners, who are the Lord Chancellor, the Master of the Rolls, and the Law Officers. Three Commissioners would be appointed on account of their special knowledge.

APPLICATION FOR LETTERS PATENT.—METHOD OF GRANTING SAME.—The method of application for a Patent would be somewhat as follows:—The applicant would file a Provisional Specification, which would be referred to Examiners appointed for the purpose. They would see that the invention was proper subject-matter for a Patent; that the Specification fairly described the invention; and that it was generally intelligible and properly drawn. They would not inquire into novelty or utility. They would report, and their report would be shown to the applicant before being seen by the *Commissioners*. The applicant would then have an opportunity of conferring with the Examiners as to any required alterations. Provisional Protection would be granted immediately on receipt of the application, and would last for nine months. Before the end of that time the applicant would be required to file a Complete Specification, fully describing his invention. This would be referred to the Examiners, and treated in the same manner as the Provisional Specification. The applicant would be enabled to amend his Specification in accordance with the recommendation of the Examiners, and, on his doing so, a Patent would be granted. If the Examiners reported that the application was in respect of matters which could not properly be made the subject of a Patent, and if the applicant still persisted, a Patent would still be granted, but the objections of the Examiners would be endorsed upon the Specification.

DURATION OF PATENT.—The duration of Letters Patent would be increased to 17 years—the duration being as now contingent upon the payment of fees at or before the expiration of each period.

FEES.—The fees would be half the present amounts, namely—

Fee for Provisional Protection	£2	10
Fee for Grant	10	0
Fee at expiration of fourth year	30	0
Fee at expiration of eighth year	60	0

OPPOSITION.—Under the proposed Bill, opposition to the granting of Letters Patent would be limited to persons who could state that the applicant had obtained the invention from them by means of fraud. Under the present law any person can oppose, the general ground of opposition being that the person opposing already has a Patent for the same or nearly the same invention.

AMENDMENT.—The Bill provides that the inventor should be entitled to amend his Specification after it had been first filed. Under the present system this power is very restricted.

PROLONGATION.—It is proposed to continue the system of prolonging Patents in special cases, the Bill being framed in such a manner as to give greater facility for this than now exists.

OBLIGATORY LICENSES.—The Bill would compel a Patentee to grant licenses in cases where it could be clearly shown that the invention was not being worked in such a way as to supply the reasonable wants of the public; but the clause has been so worded as to prevent any improper interference with the rights of the Patentee over what is considered to be his own private property.

TRIAL OF PATENT CASES.—The Bill would provide for the trial of Patent cases in an entirely new manner. They would be tried, in the first instance, before one of the Commissioners, and an appeal would lie to the whole body. The Commissioners would have power to call in Assessors, and would have such other powers as would enable them to try the cases fully.

ANTICIPATION.—It is proposed that a mere publication more than 30 years old, unaccompanied by use within the 30 years, should not be considered sufficient to invalidate a Patent. The object of this is to remove the hardship which now not infrequently occurs of a Patent being invalidated, or a Patentee being put to great expense in order to prove his claim, by the discovery of some ancient and probably incomplete description, a description which in many cases could not have been put into operation at the time it was made, for want of necessary appliances to carry it into effect.

PATENTS TO FOREIGNERS.—It is proposed that Patents should be granted to foreigners or persons resident abroad on precisely the same terms as those on which they are granted to British subjects resident in the United Kingdom.

Effect of Foreign Patents on English 'atents.—At present an English Patent lapses at ıe expiration of any Foreign Patent taken out by the ame inventor for the same invention. It is proposed ı the Bill that English Patents should not in any way e affected by Foreign Patents.

ITY AND GUILDS OF LONDON INSTITUTE.

'his institution for the advancement of technical lucation, strong and vigorous, although still quite in s youth, has recently issued a report of the third camination, held on the evenings of the 25th and 26th Iay last. Under the head of telegraphy we find that) candidates presented themselves, and out of that umber 49 passed, whilst 50 failed. Electro-metallurgy roduced but four candidates (against six last year); vo passed and two failed. In the extracts from the :ports of the examiners we note the following remarks y Mr. W. H. Preece, F.R.S., examiner in the subject : telegraphy:—"I have upon a previous occasion :marked upon the absence of any drawings to illustrate ıswers. It is surprising what small use is made thus f the pen and pencil. A simple sketch would often otain more marks than a whole page of writing. One :quest in the questions was to describe a telephone; nd, although this instrument has been before the 'orld for four years, and has been talked of more or :ss all over the world, nothing is more astonishing ıan to note the few correct answers which have been ;iven."

"There seems to me to be in many places an absence f apparatus for examination. It is very easily found y the character of the answers when the examinee is ı telegraph clerk, with the use of telegraph apparatus it his office."

The sub-committee, having had under their consideration the results of the recent examinations in technology, and also various suggestions from the examiners and teachers of the institute, as well as the report of the director's visit of inspection to several technical classes in the north of England in connection with the institute, have resolved to recommend to the executive committee the adoption, for 1882, of a revised set of regulations.

These regulations differ from those contained in the programme for 1881 in several important particulars; those referring to subjects more immediately connected with electrical science run as follows:—

"The great and increasing importance of industries connected with the various applications of electrical science has induced your sub-committee to suggest the introduction into the programme of an examination in Electric Lighting and the Transmission of Electrical Energy, and also in another industry, to which special attention has been given in the Cowper Street Classes, viz., Electrical Instrument Making. These subjects, together with Telegraphy, it is suggested, should be grouped under one heading, viz., "Electrical Engineering."

The programme for the City Technical Science Classes, Session 1881-1882, has also been issued.

During the winter term, commencing October 3rd, 881, Professor Armstrong, Ph.D., F.R.S., and Professor Ayrton, F.R.S., will continue their tutorial and laboratory courses of instruction in chemistry and physics at he Cowper Street Schools, Finsbury, in rooms rented rom the Middle Class School Corporation, pending he completion of the City and Guilds of London 'echnical College, Finsbury.

From this time the Trade Classes transferred from the Artisans' Institute, St. Martin's Lane, W.C., will also be conducted in the same building.

The Physical Laboratory will be open daily (Saturdays excepted) from 10 to 5 p.m., and on Monday and Wednesday evenings from 6.30 to 9.30 for students desiring individual practical instruction in Technical Physics. The fees are inclusive of apparatus and materials.

There will also be the following classes and lectures:—Professor Ayrton will continue on Monday evenings, from 8.30 to 9.30, commencing October 3rd, the course on Electrical Instrument Making, and give practical instruction in the scientific principles underlying the manufacture and testing of condensers, induction coils and telephones. The students will have the opportunity of performing themselves the experiments suggested at the lectures, as well as of obtaining information from the professor regarding technical difficulties, by attending a special laboratory course, to be held on Monday evenings, from 6.30 to 8.30, commencing October 3rd.

The syllabus of the course on Electrical Instrument Making includes such subjects of study as condensers, submarine duplex telegraphy, induction coils, and telephones.

On Wednesday evenings, from 8.30 to 9.30, from October 5th, Professor Ayrton will continue the course on the Electric Light, especial attention being devoted to the construction of the various forms of generators, and to the laws governing their action and efficiency. The practical application of the principles of the electric transmission of power to electric railways will be entered into, and a critical examination made of the various systems of electric lighting at present employed in London.

A special laboratory class for students attending this course will be held on Wednesday evenings, from 6.30 to 8.30, in which students will be taught to make exact measurements of electric currents, electro-motive forces and resistances, and to practically use absolute instruments when very strong electric currents have to be measured. They will then practise making measurements of the illuminating power of electric lights produced by various strengths of electric current, generated by dynamo-electric machines driven by a six horse-power gas engine in the laboratory fitted with suitable gearing to enable the dynamo-machines to be run at any desired speed; and they will compare the relative illuminating powers with the energy absorbed in the arc in each case, so as to determine experimentally the relative efficiencies of different forms of electric lighting. The students will also experiment on the sensibility of the various lamps as regards their automatic adjustment, and on the efficiency of dynamo-electric machines relatively to one another, and to batteries for the production of the electric current. Experiments will likewise be made regarding the practical efficiency of electric transmission of power under various conditions.

The syllabus of the course on the electric light and transmission of power includes such subjects as the "General Principles of Electric Transmission of Power," "Generators of Electric Currents," "Electric Railways," "Present Electric Lighting of London."

On Friday evenings, from 7 to 8.30, commencing October 7th, a course of lectures will be given on the classified series of electrical experiments which have been arranged in the laboratory to enable students to verify the fundamental principles and laws in electricity and magnetism.

The syllabus of the course on electrical laboratory apparatus contains also the following subjects in their

various branches: "Electrification," "Conduction," "Insulation."

There will likewise be a preliminary course of lectures on Electricity and Magnetism, fully illustrated with experiments, which will be delivered on Tuesday and Thursday afternoons, from 1.45 to 2.45, commencing October 4th. This preliminary course, although a continuation of the one commenced at the beginning of this year, will be so arranged that it may be joined by new students desirous of obtaining such preliminary training as should be possessed by students proposing to study any branch of electrical engineering.

A laboratory class adapted to the students attending this course of lectures will be held on Thursdays, from 10 a.m. to 1 p.m.

Students attending regularly any of the chemical or physical courses during the entire session, and passing a satisfactory examination, will receive a qualifying certificate, entitling them to the full technological certificate of the institute on passing the technological examinations in allied subjects.

Altogether, it may truly be said that the instruction proposed by the various professors is of a most interesting and thorough nature. We doubt not that a great increase in the number of students will prove that the young men of the present day are ready to benefit by the instruction which scientists and their supporters are so energetic and liberal in placing within their reach.

THE CONGRESS OF ELECTRICIANS AT THE PARIS ELECTRICAL EXHIBITION.

THE Congress, which is to be held at the Paris Electrical Exhibition, will be divided into three sections; the first will consist of physicists, chemists, physiologists, and persons who study electricity from a theoretical point of view. The second section will include telegraphic and railway engineers. The third section will be formed of electricians and engineers, and others who are employed in both the civil and military applications of electricity.

The meetings of each section will be held at different times, so that the members of any one section may be able to contribute papers to any other section. The Séances which will be held will be threefold:—1st. "Séances Plénières," in which International matters requiring a vote from the Congress will be discussed. 2nd. "Séances des Sections," in which matters of special interest will be considered in which an exchange of ideas can be given. 3rd. "Séances Publiques," in the form of conferences, in which any subjects which may be suggested will be discussed.

In the "Séances Plénières" the general questions for discussion will be—

1st.—Electrical Units.—The adoption of an international system. The points to be considered under this head will be—

1. Necessity for the adoption of a uniform system.
2. Choice of a system and names to be given to the units.
3. Measures to take for the establishment, the preservation, and reproduction of the units.
4. Should an international commission be established?
5. Should the electrical standards be under the same department as the weights and measures.

2nd.—International Telegraphy.—Measures to be taken to facilitate the working of international telegraph lines. The points to be considered under this head will be—

1. The means to assure the employment of the same electrical terms and units.
2. The possibility of the systematic study of earth currents.
3. Regulation of the establishment of submarine cables as regards their juxtaposition and crossing.
4. Signals, &c., to distinguish cable ships.

3rd.—Various Applications of Electricity.—Measures to take to facilitate scientific international relations as regards that which concerns certain special applications of electricity. The points to be considered under this head will be—

1. The electric light. The facilitation of the comparison of luminous intensities.
2. Electrophysiology. The effects obtained in the employment of electro-chemical apparatus.
3. Lightning conductors. Collection of statistics with reference to the comparison of the relative efficiency of conductors at present in use.

In the "Séances des Sections" the general questions for discussion will be—

1st Section.—Theory; Sources of Electricity; Lightning Conductors; Electrophysiology. The points to be discussed under this head will be—

1. The theory of electricity.
2. The measurement of currents of great intensity, whether alternate or continuous.
3. The physique of the globe. Atmospheric electricity and terrestrial magnetism.
4. Lightning-rods. The best conditions for the establishment of lightning-rods, and the possibility of statistical compilations as to their efficacy.
5. Electrophysiology, and the necessity of a system of measurement in units in connection with the same. The best means to determine the nature of electric phenomena produced in animals.
6. Miscellaneous questions initiated by members.

2nd Section.—Transmission of signals and speech by electricity; telegraphy, telephony, and railways. The points to be discussed will be—

1. The relative efficiency of dynamo machines and batteries for telegraphic purposes. Best conditions for establishing open or underground lines as regards their conductivity and insulation. Advantages and disadvantages of relays on long lines. Lightning-protectors for instruments. Advantages and disadvantages of wire protectors.
2. Telephony. Difficulties in establishing telephonic communication. Telephonic disturbances.
3. Railways. Application of electricity to railway purposes. Comparison of the relative efficiency of automatic and hand-worked signals.
4. Questions initiated by members of the Congress.

3rd Section.—Industrial applications of electricity. The points to be discussed will be—

1. Electric lighting. The adoption of a unit of luminous intensity. Possibility of the establishment of simple rules for photometric measurements. Comparison of the relative efficiency of direct and alternate current machines. Special conditions as regards the application of the electric light to towns, worshops, mines, ships, &c.
2. The transmission of power. Known facts in connection therewith, and results obtained. Difficulties in connection with. Utilisation of natural forces.
3. Industrial distribution of electricity.

4. Clocks, chronographs. Applications to geodesy.
5. Electro-metallurgy. Applications of electricity to chemistry.
6. Questions initiated by members of the congress.

"Séances Publiques." The suggested programme is as follows—

1. Electric measurements.
2. Electric light.
3. Transmission of power.
4. Telephony.
5. Atmospheric electricity and lightning-conductors.
6. Terrestrial magnetism.

ERRATA.

Aug. 15th, page 314, *Molecular Torsion and Molecular Magnetism*, by G. Gore. First col. page 314, third line from bottom, read "2·75 metres" for "2·75 mm.;" second col. page 314, second and third lines from top, read "a current flowing" for "a current following."

Correspondence.

ELECTRIC LIGHT.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—From time to time, as you are aware, in addressing your Journal on the topic of the various systems of electric light, I have dwelt upon the fact that "simplicity" in the arrangements of the lamp is absolutely necessary for efficient working. Many of the regulating systems, when workable, produce no doubt a grand light, but the difficulty seems to be to render them workable. "Regulators," as before said in a former letter, require "lamp-lighters to regulate the regulators;" this was prominently noticeable at Covent Garden the other evening. I observed the Brush lights burning but badly, particularly in the Floral Hall, where they had seven lamps. During two hours' close watching, the whole seven lamps in this hall were never at one time in workable order; one was all but out, and as it temporarily recovered itself, another followed suit, and so they went on, playing bo-peep, until, during the interval, when the hall was crowded to suffocation, the entire system broke down, leaving the hall in total darkness, save a few gas jets, burning over the buffet. *If* pickpockets were among the crowd, and chose to ply their avocations, they certainly had an opportunity. The cause of the extinction was no doubt the failure of the regulators to regulate the lamps; there was no want of attendance, as the electric lamp-lighters were cutting about in all directions. Before concluding, a word upon incandescent lights, and the supposed candle-power of regulators: as regards the former, they are more or less of the same calibre, ten to twelve candle-power, and new ones seem to shine forth monthly. For the small cabins of ocean steamers they are perhaps suited, but I am afraid they will be found an expensive light (if they *really* possess true illuminating power at all); for instance, a 20 horse-power engine which drives sixty lights on the Thames Embankment of over 200 candle-power each, would hardly, I believe, suffice to drive 40 incandescent lamps of, as above said, 12 candle-power; there is thus an enormous difference in the power required. Touching the latter, viz., the candle-power of the various regulators, I think it is high time that the owners of such should be compelled to have them measured photometrically, and not be allowed to give forth to the public that a lamp is of 1 to 6,000 candles. I see in one of this morning's papers an account given of the Compton, in which one of their lamps is called 6,000 power? Were this lamp tested by the Board of Works, the probability is, it would have to sing very small; and it is unfair that the public should be deceived by circulars or advertisements, stating the light power based merely on a supposed or imaginary standard. One large regulator company, who described their lights as 1,000 candle-power, I know, have been tested by the photometer and found to be little over one-half.

Yours obediently,

ELECTRON.

Junior Carlton Club,
August 12th, 1881.

Notes.

ON AN ALTERATION OF THE ELECTRIC LAMP.—By Mr. Jamin.—As soon as he had discovered the electric arc Davy placed it in a vacuum, and observed that its length was increased and that the carbons were not consumed. Since that time many persons have endeavoured to inclose their apparatus in confined air, but never, to my knowledge in vessels hermetically closed, nor in gases which have no action on carbon at a red heat. This depended, doubtless, on the difficulties of the experiment, because of the size of the regulators. The lamp which I have described to the Academy, admitting of being reduced to a very small bulk, may be fixed either in a vacuum or in inert gases, in globes entirely closed.

Among the gases which are without action on the carbons may be mentioned acetylene, carbonic oxide, marsh-gas, and probably sulphide of carbon; most of the others are decomposed. Thus the vapour of water gives carbonic oxide as acetylene, carbonic acid doubles its volume and is converted into carbonic oxide, the carbides of hydrogen, and especially the vapour of petroleum, are decarbonised and give rise to filaments of coke, which connect the carbon points and convert the arc-apparatus into an incandescent burner.

Air offers an especial interest. We see the globe at first filled with reddish vapours, from the combination of the oxygen and nitrogen under the electric influence. This compound is soon decomposed, and the gas becomes colourless again. It is evident that the hypo-nitric acid, after having been formed under the electric influence, is decomposed in turn so as to supply oxygen to the carbon. Finally there remain mere carbonic oxide and nitrogen.

During this time the electric arc undergoes corresponding modifications. As long as there are reddish vapours it varies both in intensity and colour, but as it is decolorised the flame becomes stable and changes its hue. When all the chemical changes are completed, it is reduced to a well-defined arc, of a greenish blue, unmixed with other colours. It becomes absolutely stable without any fluctuation in its intensity, or variation in its colour or position. I have never, in any case, remarked so complete a stability which, of course, involves the same invariability in the brightness of the points. I believe that this circumstance is of the utmost importance as relieving us from the irregularities met with in all carbons.

The spectrum is furrowed by an incredible quantity

of very fine and almost regular rays. We remark in it four great maxima, which arise abruptly from the more refrangible side with a very bright line, which is repeated afterwards at equal intervals, but growing fainter. These maxima are in the yellowish green, the blue and the violet. They only remain visible when the light diminishes. This is the electric spectrum of the vapour of carbon rendered incandescent, but without burning.

It is different in the air: the carbon burns, the arc is red, and the former spectrum and another due to combustion, and which is totally different, follow each other at regular intervals. It presents a splendid collection of bright rays, due to the combustion of the metals contained in the carbon. It is clear that in an inert gas we have a simple phenomenon, purely electric. The arc is a current which we can direct and keep invariable at the points of electro-magnetic actions; hence the light takes so remarkable a stability. In free air, on the contrary, the phenomenon is complex. There is still a current which we may fix, but there is also the combustion of the carbons against which we are powerless. It varies from moment to moment from the want of homogenity of the carbons, which occasions those fluctuations of which the electric light is justly accused.

If we operate in confined air we observe at first the spectrum of combustion. As soon as the chemical changes begin the electric spectrum appears. The two are never seen together; they succeed each other alternately; gradually the duration of the combustion-spectrum decreases, whilst that of the electric spectrum increases, and at last becomes permanent.

It is very noteworthy that in the two cases the arc is characterised by spectra so unlike each other, and that the oscillations of the light are merely a mark of the transition from one spectrum to the other.

What must concern us still more is that the carbons as they cease to burn cease to waste. If we operate in the air with a medium current, we expend about 0·16 metre of "candle" per hour; and as there are five "candles" of 0·32 metre per lamp, this is a duration of ten hours, or one night. In the closed apparatus, in proportion as the gas is transformed, the consumption decreases rapidly and is reduced to about 0·002 metre per hour. Each candle lasts 160 hours, each lamp 800 hours, or 80 nights of 10 hours each.

It may be said that the electric light becomes perpetual; that it is sufficient to replace the carbons when it is needful to clean the lamp; that the consumption of carbons is almost at an end; that their quality becomes indifferent; that all daily attention is suppressed, while the light acquires a constancy hitherto unknown. It may be added that in virtue of its former properties the lamp is lighted spontaneously as soon as the circuit is closed.

Practically, the dimensions of the glass globe which contains the burner should be reduced as much as possible; great care should be taken to prevent the entrance of air while the globe cools, though the gas within must be allowed to escape by means of a valve while the lamp is in action.—*Comptes Rendus*.

Dr. Butler's Electro-Massage.—A large portion of electrical treatment that hitherto could only be carried out by specialists, by using elaborate apparatus, by the proper use of a new mode of treatment, by employing the apparatus shown in the engraving, can be intrusted to the hands of those who are not so skilled.

By means of this simple machine the manipulator transfers the mechanical motion used in rubbing the patient into an electrical current, and the current as it is generated is transmitted through the part while being rubbed, and it fulfils the requirements of a treatment including rubbing, kneading, pounding, flexing, &c., combined with the application of the electric current.

The instrument consists of a metallic roller, covered with chamois leather or other suitable material, an electro-magnet, and a permanent magnet set in a strong frame, which holds the instrument together. The roller, besides acting as the driving wheel of the machine, is so arranged that it also acts as one of the electrodes by which the current is transmitted, and is connected by gearing with the electro-magnet so as to cause the poles of the latter to revolve opposite those of the permanent magnet, which forms the handle of the instrument. Each revolution of the roller produces

twenty-five revolutions of the electro-magnet, which is magnetised and demagnetised at each revolution, and thus induces a current of electricity which is ample for all purposes for which it is intended. The circuit is completed by connecting any required electrode by the binding post at the side of the instrument, the roller acting as the other electrode; both are brought into contact with the surface of the body of the patient, and as the roller is moved about over the surface, the current is established and transmitted through the part over which the roller is made to revolve.

The machine includes in itself an electric generator, a rubber, a kneader, a manipulator, and a set of electrodes, all in one. Any person of ordinary intelligence can be taught to use it under the direction of the attending physician. It is portable, being quite capable of being carried in an overcoat pocket.

The inventor finds in practice that it has far exceeded his expectations, inasmuch as by its use he gets greater tonic effects than from the employment of both faradism and massage separately. It fulfils most of the requirements of the induction current in general practice and every-day cases. As the current is generated by motion, no acids or liquids of any kind are necessary. The instrument is at all times ready for use, a matter that will be appreciated by all who use electricity.

This treatment has been used with great success in cases of nervous exhaustion, debility, neuralgia, rheumatism, paralysis, &c., and we are informed that it is recommended by the medical profession generally. —*Scientific American*.

On the Application of Electric Motors.—By M. G. Trouvé.—I had the honour of submitting to the Academy, in its session July 7th, 1880, a new electric motor, founded on the excentricity of the play of a Siemens' coil. By successive studies, which have permitted me to reduce the weight of all the parts of the motor, I have succeeded in obtaining the following results, which appear to me worthy of notice:—

A motor, weighing 5 kilos., impelled by 5 Planté's secondary elements, producing an effective work of 7 kilogrammetres per second, was placed on the 8th of April upon a tricycle, the weight of which, including

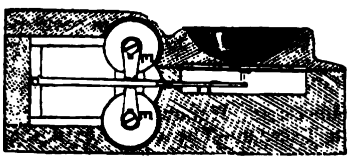
the rider and the batteries, reached 160 kilos., and impelled it at the rate of 12 kilometres per hour.

The same motor placed on May 26th upon a boat 5½ metres in length, by 1·20 metre in width, and containing three persons, gave it a speed of 2¼ metres (per second?) whilst descending the Seine to the Pont Royal, and of 1½ metre on returning. The motor was worked by two batteries, each of six bichromate elements, and the propeller was a screw with three blades.

On June 26th I repeated the experiment on the calm water of the upper lake in the Bois de Boulogne, with a screw of four blades of 0·28 metre in diameter, and twelve flat Bunsen elements, of Rhumkorff's modification, charged with 1 part hydrochloric acid, 1 part nitric acid, and 2 parts water, in order to reduce the escape of hypo-nitric vapours.

The speed at the outset, as measured by an ordinary log, was exactly 150 metres in 48 seconds, or rather more than 3 metres per second; but after working for three hours it fell to 150 metres in 55 seconds. After five hours' action the speed was still 2·30 metres per second, as the 150 metres were traversed in 65 seconds. —*Comptes Rendus.*

A PATENT (No. 244,442, dated Sept. 10th, 1880) has been taken out in the United States by Mr. F. K. Fitch for the telephone represented by the figure.



The instrument consists of a polarised Siemens' armature, operated upon by the opposite poles of an electro-magnet, the armature being connected to the centre of a diaphragm.

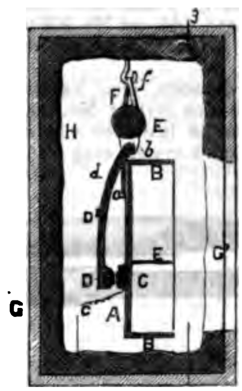
A COMPANY is in process of formation, consisting of Englishmen, French, Norwegians, and Danes, with the object of laying a cable, by way of the Faröe Islands, to Iceland.

A DEPUTATION from Ramsgate, consisting of Mr. Hobbs, Rev. Mr. Gilmour, and other gentlemen, waited upon Sir Thomas Brassey, at the Admiralty, on the 19th ult., and presented a petition bearing 10,000 signatures in favour of telegraphic communication being established between lighthouses and the shore, to be used in case of storms. Sir Thomas Brassey promised attention to the representations made to him.

THE United States Underground Telegraph Company has laid an experimental series of 72 wires, extending from the head-quarters of the Fire Department in Mercer Street to police head-quarters in Mulberry Street. The wires are laid in long wooden boxes covered with a preparation of silica and other substances designed to exclude dampness and secure perfect insulation. It is said that if the present experiment is successful the system will be extended so as to include the police-stations, engine-houses, and fire-alarm boxes.

THE Polytechnic Institution, Regent Street, which was founded in 1831 for the exhibition of novelties in science, has been closed.

THE Superior Committee of the Electric Exhibition, with M. Teisserenc de Bort in the chair, have handsomely decided that, though there are 1,200 French exhibits and but 500 in all the foreign sections, the international jury shall consist of French and foreign members in equal numbers. The foreign sections are requested to propose jurymen in proportion to their exhibits. The minimum number of the jury is fixed at 100. The committee will place at the disposition of the jury 50 gold medals, 200 silver, and 500 bronze.



THE figure represents a telephone patented (patent No. 244,638, dated Jan. 5th, 1881) in the United States by Mr. W. Main. The apparatus consists of an acoustic vibrator formed of a plate of resonant wood suspended from above so as to be perfectly free to swing backwards and forwards, or to vibrate. The transmitting arrangement consists of a resistance varying electrode in combination with a second contact, the two contacts being pressed tightly together by the force of gravity, owing to the curved shape of the electrode arm.

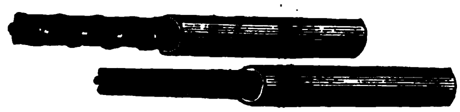
FIRED BY ELECTRICITY.—An interesting illustration of the danger attending the manufacture of some kinds of rubber goods was shown in the origin of the recent fire which occurred in the Ætna Rubber Mills, at Jamaica Plains. The cement which fastens the seams of rubber coats is largely made of naphtha. The mere act of lifting a piece of rubber cloth from a pile of half-a-dozen similar ones, cut for garments, developed so much electricity that a spark was observed to escape. It came in contact with the naphtha cement, or with gases arising from it, and instantly the whole room was in a blaze. Fortunately the fire was extinguished without destroying the mill, the loss being only about a thousand dollars. It is not known that anything can be done to prevent the occurrence of another accident of precisely the same kind, whenever all the atmospheric conditions are favourable. One would suppose, however, that a certain degree of dampness would remove all danger from that source.—*Commercial Bulletin.*

THE Technical Committee of the Electrical Exhibition, under the presidency of the Minister of Posts and Telegraphs, has urged M. Berger, the Commissary General, to organise a series of elementary lectures, illustrated by experiments, on some of the chief electrical inventions exhibited.

IN Canada there are 35,000 miles of telegraph-wires; there is one office to every 2,430 persons, while in this country there is only one office to every 5,860 persons.

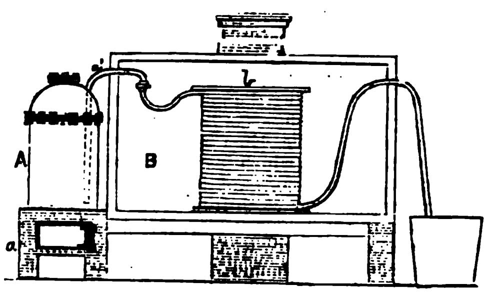
IF Mr. Edison intends, as he now promises, to illuminate 500 houses in this city with his electric light by the 1st October, the gas companies do not seem to be scared. It has been recently shown that New York now pays two and two-third times as much for gas as London, two and a-half times as much as Ghent, twice as much as Amsterdam, Berlin, or Brussels, and half as much again as Paris, Lyons, or Marseilles. While coal sells for five dollars a ton in London, and four dollars in Philadelphia, the price of gas in the latter city is three times what it is in London. Here, then, would seem to be a fine field for some acceptable substitute for gas, and yet Mr. Edison and his brother inventors do little more than talk.—*Operator.*

MR. DAVID BROOKS, jun., has recently taken out a patent in America (patent No. 244,790, dated May 20th, 1881) for an insulated wire cable as shown by the figure. In this system each insulated wire is partly



covered or wound with a thin ribbon or wire of metallic foil, a small space being left to afford access of the insulating fluid to the insulation of tissue, cotton, or other fibre. A number of such wires are bound by a metallic strip and introduced into a lead pipe, or the binding-wires are omitted and wires introduced unbound. Induced currents are thus conveyed away.

IN connection with the oil insulation system, Mr. Brooks has also taken out a patent (No. 244,791, dated

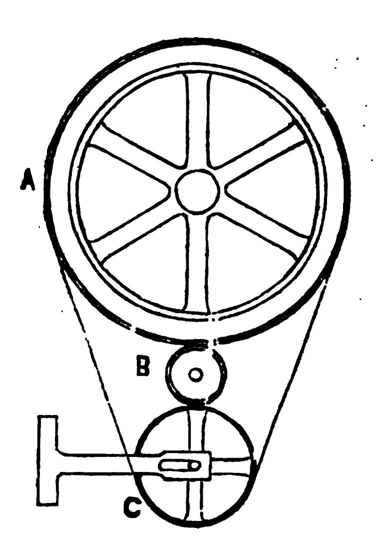


Nov. 29th, 1880) the subject of which is an air-tight vessel, A, heating apparatus, *a*, pipe, *a'*, and chamber, B, containing the conductor or pipe, combined as shown, whereby the pressure created within said vessel by the volatilisation of a portion of the insulating fluid forces the fluid material into the conductor in the chamber, B, and insulates the wires.

M. SAMUEL, of Ghent, has brought before the Belgium Academy a method of registering telegraphic signals received through the mirror galvanometer (*Bull.*, No. 5). On the screen receiving the light are fixed two selenium elements, one to the right, the other to the left. When either is illuminated its conductivity of course increases, and it acts as a relay on an electro-magnet, which causes a Morse dot or dash to be marked on paper. There are two local batteries, one having two circuits, which pass through the selenium pieces and the electro-magnets, while the other is electro-chemical writing. In this latter, a paper saturated with iodide of potassium pass nuously over a small copper cylinder which nected with one pole of the second battery. A paper are the ends of the armatures of the magnets; to one is attached a vertical plati to the other a small triangle with platin (horizontal). The rod and triangle are co through the armatures, with the other pol second battery, and they press the paper ban cylinder each time the armatures are attracted a dot or a dash as the case may be. Th instead of being longitudinal, are at right angl length. If the ordinary lamp of the galvano replaced by sunlight or limelight, the electro- (M. Samuel points out) may be actuated without use of a galvanometer relay, Bell's elements having an average resistance of only 1 in sunlight, and 300 ohms in darkness.—*Natu*

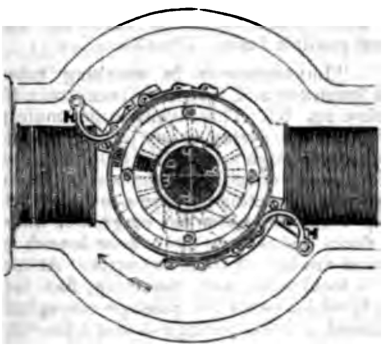
THE ICELAND CABLE.—With reference to t posed telegraph cable to Iceland, the *Standard* pondent at Copenhagen states that he had an i with M. Madsen, the telegraph engineer, who la of the submarine Chinese and Japanese cabl who is now the consulting engineer and superin of the Great Northern Telegraph Compa Madsen assures him that all the calculations a for laying the cable are ready, and work can be begun. The cable is to start from some point North of Scotland, probably from the place Thurso. The cost will amount to about £250

KILLINGWORTH HEDGES' PORTABLE E LIGHTING TACKLE.—The object of this tackl enable dynamo-machines to be run from an e a high speed without the usual gearing and



noise. The apparatus as shown by the figure con an ordinary friction pinion driven by a heavy fixed on the engine shaft, and also by a strap en the fly-wheel, and an idle wheel running loose own shaft. The latter is pressed up to the inter wheel by the strap which consequently halves th by lowering this wheel the strap can be tighten

figure shows a dynamo-electric machine (patent No. 245,260, dated May 23rd, 1881) Jnited States, by Mr. W. Hutchinson. The s is described as being an improvement on of the Pacinotti type, and consists in the ıent of commutator-brushes so located rela-



the bobbins that the bobbins which are enter- eld are short-circuited, while the currents are from those which are leaving the field. The nents in the armature-core consist in con- it of segmental plates with insulated over- ends and securing the sections together by netic rods or bolts; also in the peculiar form gmental plates.

'OSTAL AND TELEGRAPH SERVICES.—Mr. G. Macliver, M.P., has given notice of the follow- ion:—"To move, early next Session, for a Committee to inquire into the working and nent of the Postal and Telegraph Services, ew to ascertain whether increased facilities and tes cannot be afforded; and also to consider ort on the relationship of the letter-carrying graph services to each other, and the best securing efficiency in both branches, having o their constantly-increasing importance in ring on social and commercial life."

New Patents—1881.

"Improvements in electric lamps and apparatus d therewith, part of which improvements is plicable to other electrical purposes." J. SON. Dated August 3.

"Working gear and appliances used in electric K. W. HEDGES. Dated August 3.

"Improvements in apparatus for detecting and the passage or stoppage of an electric current a conductor, applicable for telephones and other ipparatus, and for purposes for which ordinary clocks are now applied." W. D. THOMPSON. nicated by J. A. Pel.) Dated August 4.

"Improvements in electrically actuated indi- d in transmitters for controlling the operation ame." J. C. MEWBURN. (Communicated by nd.) Dated August 4.

3386. "An electric organ." W. F. SCHMOELE and A. MOLS. Dated August 4.

3388. "Improvements in continuous underground pipes and in methods of forming and laying the same for telephonic and telegraphic wires." C. DETRICK. Dated August 4. (Complete.)

3394. "Means or apparatus for generating electric currents and for producing motion by electricity." ST. G. LANE FOX. Dated August 5.

3400. "Electric machines or apparatus for generating electricity." J. H. JOHNSON. (Communicated by J. B. J. Mignon and S. H. Rouart.) Dated August 5.

3402. "Improvements in electric lamps and in the manufacture of carbons for the same, and in apparatus employed in such manufacture." J. H. JOHNSON. (Communicated by J. B. J. Mignon and S. H. Rouart.) Dated August 5.

3404. "Apparatus or appliances for automatically lighting electric candles." E. G. BREWER. (Communicated by A. G. Desquiens.) Dated August 5.

3405. "Telephonic and telegraphic apparatus." T. A. CONOLLY. Dated August 6.

3409. "An improved method and apparatus for regulating the dynamical production of electricity. G. WESTINGHOUSE. Dated August 6.

3412. "An improved fluid to be used in galvanic batteries." T. COAD. Dated August 6.

3435. "An improvement in electric lamps operating by incandescence." F. WRIGHT. Dated August 8.

3437. "Electric lamps operating by incandescence." F. WRIGHT. Dated August 8.

3441. "Improvements in and appertaining to apparatus for generating electricity and means for utilising the same in producing the electric light." R. R. MOFFATT and S. CHICHESTER. Dated August 9.

3455. "Improvements in electric lighting and in the apparatus employed therein." W. E. HUBBLE. (Communicated by A. F. W. Partz.) Dated August 9.

3456. "Improved electrical apparatus for lighting and other purposes." W. R. LAKE. (Communicated by A. L. Arey.) Dated August 9.

3463. "An improved form of chain for protecting submarine telegraph cables and for connecting them with floating vessels, also other appliances to facilitate establishing telegraphic communication with lightships." F. R. LUCAS. Dated August 10.

3464. "An electric brake." S. VON SAWICZESKI. Dated August 10.

3472. "Construction of dynamo-electric machines." E. J. HARLING and E. HARTMANN. Dated August 11.

3473. "Improvements in electric lamps, part of which improvements are applicable to other purposes." E. J. HARLING and E. HARTMANN. Dated August 11.

3483. "Electrical distribution systems." E. G. BREWER. (Communicated by T. A. Edison.) Dated August 11.

3485. "Generating and applying electricity." J. L. PULVERMACHER. Dated August 11.

3509. "Electrical interruptors." P. ULLATHORNE. Dated August 12.

3519. "Means or apparatus employed in lighting gas by electricity." B. J. B. MILLS. (Communicated by L. A. W. Desruelles and G. J. A. E. Bourdoncle.) Dated August 13.

3538. "Improvements in the method and apparatus for registering by means of electricity the number of picks woven per inch in looms for weaving." J. PORRITT. Dated August 15.

3539. "Electrical apparatus chiefly designed for telegraphic and telephonic purposes." W. R. LAKE. (Communicated by C. Williams, F. W. Harrington, and T. W. Lane.) Dated August 15.

3555. "An improved means or apparatus for conveying messages and articles of property from ships." H. REDKNAP. Dated August 16.

3559. "Improvements in electric lighting and in the means or apparatus employed therein." C. W. HARRISON. Dated August 16.

3599. "Electric lamps." C. LEVER. Dated August 18.

3635. "Production of the electric light." T. TUBINI. Dated August 20.

3650. "Electric lamps." G. PFANNKUCHE. Dated August 22.

3652. "An improved coiling machine." C. L. CLARKE and J. LEIGH. Dated August 22.

3655. "Division and regulation of electric currents." R. E. DUNSTON and G. PFANNKUCHE. Dated August 22.

3668. "Electric lighting apparatus." W. R. LAKE. (Communicated by T. A. Conolly.) Dated August 23.

3679. "Electric light regulators." S. PITT. (Communicated by S. J. Burrell.) Dated August 23.

3696. "Electric magnetic clocks and batteries for the same and other purposes." C. SHEPHERD. Dated August 24.

3711. "Electric lamps." F. H. F. ENGEL. (Communicated by C. H. F. Müller.) Dated August 25.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1880.

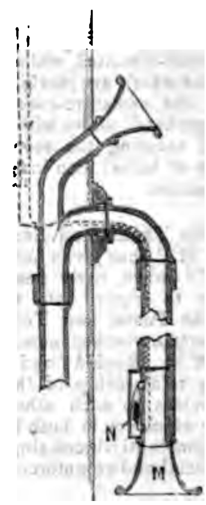
1397. "Electric lamps," &c. CHARLES DENTON ABEL. (A communication from abroad by Franz Krizik and Ludwig Piette, both of Pilsen, in the Austrian Empire.) Dated April 6. 6d. Relates to the lamp described in the No. of the Journal for Dec. 15, 1880.

4564. "Thermometers and barometers." EDGAR EDMONDS. (A communication from abroad by Otto Koch, of Berlin, and August Eichhorn, of Coethen, Germany.) Dated Nov. 6. 2d. The object of this invention is a thermometer, in the scale of which platina-wires are inserted in such a way that the ends just enter the inside of the thermometer tube, so that the platina metal comes in contact with the mercury whenever it is expanded by heat. Each platinum wire is connected to a key; and by pressing down these keys the circuit is closed upon a transverse wire in connection with an alarm bell and a battery, so that by putting down one key after the other, it can easily be ascertained which is the utmost key that closes the circuit, and thus the height of the mercury can be found. (*Provisional only.*)

4782. "Automatically counting the number of letters impressed with obliterating stamps," &c. HENRY FERGUSON and HARRY ROBERT KEMPE. Dated Nov. 19. 6d. Relates to the apparatus described in the No. of the Journal for August 1st.

4851. "Current meters." HENRY LAW. Dated Nov. 23. 2d. The meter is so constructed that the shaft or axle which is put into motion by the current, imparts its motion to a vertical shaft or axle, inclosed in a tube closed at its upper extremity, the vertical shaft being carried to the upper part of the tube, and an arrangement being there adopted by which at one point in its revolution it completes an electric circuit, which gives a signal to the observer above the surface of the water, or records the number of times that the circuit is so completed. By this arrangement the air in the vertical tube not being able to escape prevents the water reaching its upper extremity and interfering with the perfect insulation of the electric current, and the use of any kind of stuffing box is rendered unnecessary, a matter of considerable importance in an instrument in which it is desirable to reduce the friction to the lowest possible limit. (*Provisional only.*)

4887. "Improvements in speaking tubes," &c. GEORGE JENNINGS and EDWARD GRIMSTONE BREWER. Dated Nov. 24. 8d. This invention has mainly for its object to enable a person at any part of a building to communicate through a speaking tube with any one or other of a number of rooms on the several floors above, and *vice versa*. For this purpose a main speaking tube is led up from the basement or ground floor to the several floors above. At each floor branch pipes or local mains are led off from the main. At each junction of a local main with the main, flap valves are applied, by which either the passage through the main can be closed and the passage through the local main

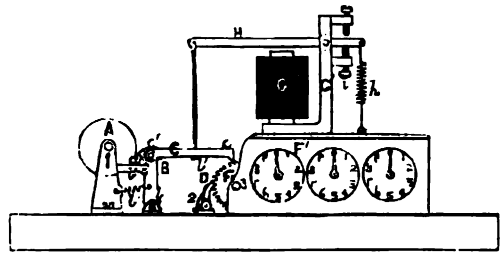


opened, or *vice versa*. In the same way branches are or may be led off from the local mains on each floor to different rooms on such floor, and valves are similarly applied at the junctions of the local mains and branches. Ordinarily the passage through the main is open from end to end, and the passages from it to the local mains closed, and similarly the local main is open from end to end, and the passages from it to the branches closed. The several valves are normally held in proper position by light springs or weights to keep the mains open and the branches closed, as above described. Together with the above apparatus is combined electrical apparatus, by which either a person at the end of any one of the branches can give a call signal to the terminal end of the main pipe and open communication from his branch speaking tube to the terminal end of the main speaking tube, or *vice versa*, that a person at the terminal end of the main speaking pipe can give a call signal to persons at the end of any one or other of the branches for them to open communication through the speaking tube with that branch. The general arrangement is shown by the figure. At the extremity of each speaking tube is a length of flexible tubing, L, carrying

ıpiece, M, which hangs downwards. Through are led two insulated wires; the ends of both brought to a contact apparatus, N, carried by ıthpiece. For this contact apparatus is used a ass tube partially filled with mercury. The end vire is led through one end of the tube, and of r wire through the other end of the tube. The nds vertically when the mouthpiece is hanging rds, and the mercury then in the bottom of the not in contact with the end of the wire which own through the top of the tube. When, how- mouthpiece is turned upwards by any person he may speak through it, the mercury drops pposite end of the tube, and is then in contact ends of both wires, and puts them in electrical on one with the other. One wire is led away f the main conducting wires from the battery, other is led through the coils of the electro- of the valve apparatus at the junction of that tube with the main, or if the speaking tube nch, the wire is led through the coils of the nagnet of the valve apparatus at the junction anch with the local main, and also through the the local magnet of the valve apparatus at the of the local main with the main, and is then d to the main return wire. In this way when ıthpiece at the end of any speaking tube is pwards a circuit is completed from the battery the contact apparatus, and acts upon such of s as required to open communication from that tube to the basement, and at the same time f all communication through the other tubes. ie speaking tube at the further end is lifted the ıort-circuited and stopped from ringing.

"Furnaces for metallurgy of copper," &c. DER MELVILLE CLARK. (A communication oad by Jules Garnier, of Paris, France.) Dated 2d. Has partly for its object to improve or ıe electrical conductibility of copper according urpose for which it is to be used. It is known per containing a small proportion of oxygen is onductor of electricity, and this invention con- liminating the last trace of oxygen contained opper, and thus greatly improving its con- y by adding to the copper in the reverberatory just before tapping, phosphorus in the form of le of copper or other suitable phosphorus com- ı proper proportion to eliminate the excess of

"Measuring and recording electric currents," SEPH WILSON SWAN. Dated December 1. is invention consists of a means of measuring currents for electric lamps and other purposes. causes a small ratchet to move backwards wards continually and to actuate a ratchet onnected to a counter. The ratchet is also d to an electro-magnet, which, when excited current, allows the ratchet to gear into the wheel; but when the current ceases, the is lifted out of gear by the armature of the nagnet rising. In the figure, A is a cylinder n suitable bearings, 1, and maintained in con- rotation by a clock or other means at a fixed , for example, one revolution in fifteen minutes. ıis cylinder are arranged a number of pins, *a* ng to the number of lights to be registered). these pins acts upon a certain set of levers; hese pins and sets of levers are shown in the A lever, B, hinged at *b*, and kept against a p, b^1, by means of a spring, b^{11}, has attached c^1 another lever or pawl, C, in such a manner own weight will cause its extremity, *c*, to engage with the teeth of the ratchet wheel, E. If now the pin, *a*, on the cylinder, A, acts on the lever, B, the pawl will thereby be caused to propel the ratchet wheel, E, to the extent of one tooth, a detent, D, acted upon by a spring, 2, serving to retain the ratchet wheel, E, in position until the same is propelled again by the pawl, C. The ratchet wheel, E, is connected with a suitable counting mechanism, F, so as to transmit motion to the same, as will be well understood. An electro-magnet, G, the coil of which is in circuit with one of the lamps, is placed under the arm, H, which is formed of iron and mounted on an iron bracket, G^1, constituting one of the poles of the magnet. The arm, H, before the passage of a current is drawn against the adjusting screw, *i*, by the spring, *h*, and thereby lifts, by means of a wire or rod, L, the pawl, C,



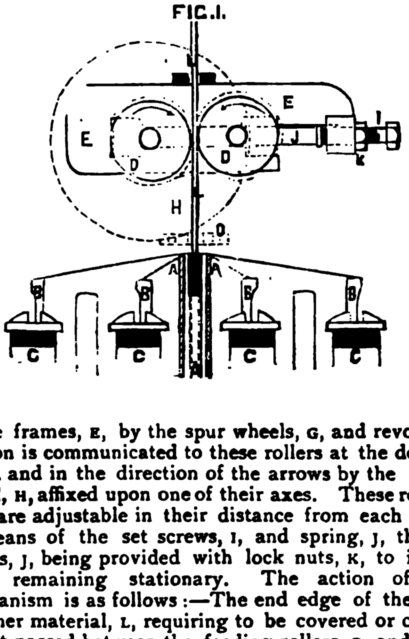
out of the teeth of the ratchet wheel, E, so that in this position of the arm, H, the movements of the levers, B and C, do not affect any movements of the ratchet wheel, E. When, however, the arm, H, is attracted by the electro-magnets, G, in consequence of a current passing through its coil, the rod, L, and with it the pawl, C, are lowered, and the wheel, E, will then be propelled one tooth for each revolution of the cylinder, A. The rod, L, passes loosely through a hole in the pawl, C, and has a small nut, b^1, by which it lifts the pawl when the arm is raised; but when the arm is attracted by the magnet it allows the pawl, C, to slide up and down the rod, L, so as to act on the wheel, E, by the to-and-fro motion of the lever, B. The ratchet wheel, E, is mounted fast on an axis, 3, of the same length as the cylinder, A, and on this axis, 3, are also keyed as many wheels, E, as there are pins on the cylinder, A. For each wheel there are the levers, B and C, and also arms, H, and electro-magnets, G. The coils of the latter are each in circuit with a different lamp, so that the number of circuits in action will cause the same number of teeth of wheels, E, to be propelled during each revolution of the cylinder, A, one counting mechanism being common to the whole.

5022. "Indicating the heating of bearings in steam engines," &c. HENRY WILLIAM WIMSHURST. Dated Dec. 2. 2d. The object of this invention is to provide a sure means for attracting attention to the bearings so soon as they are heated beyond the desired limit. A plug or stopper of fusible metal or solid paraffin, or of their equivalents, which will melt, say, at 150° Fahrenheit, more or less, according to the proportions of the alloy used, is inserted in or attached to any convenient part of the journals or working parts of the engine which are liable to get heated by friction. Against this plug or stopper one end of a weighted bell-crank lever rests in such a manner, that, directly the desired limit of temperature is overstepped, the plug, by its fusion or fracture, will liberate the said lever or spring, and allow it to act upon a gong, operate a steam whistle, establish electrical contact, or give any other

desired indication that the bearings are heated improperly. (*Provisional only.*)

5237. "Machinery for braiding, lapping, &c., telegraph wires," &c. WALTER TWISS GLOVER and GEORGE FREDERICK JAMES. Dated December 14. 6d. Relates to improvements in machinery for braiding, lapping, or coating telegraph wires, crinoline steel, engine packing, or other cores, with textile or other material. The invention consists of an arrangement of mechanism for forcing the iron, copper, or other metallic wire, requiring to be coated or covered with textile or other covering material, through the braiding or other machine employed, by means of a pair of squeezing rollers. Fig. 1 represents a side sectional view of so much of the top of the braiding spindles and hollow central tube of a braiding machine as is requisite to illustrate the application of the improved squeezing rollers which are shown applied thereto. A is the central hollow tube through which the wire or other core or cores requiring to be covered is or are to be forced; and B, B, are the tops of the braiding spindles, the bobbins of which are marked C, C. These spindles revolve round the central hollow tube, A, in the ordinary manner, and no novelty is claimed in them. At a convenient distance above the mouth of the hollow central tube, A, are mounted a pair of squeezing rollers, D, D, which are geared together

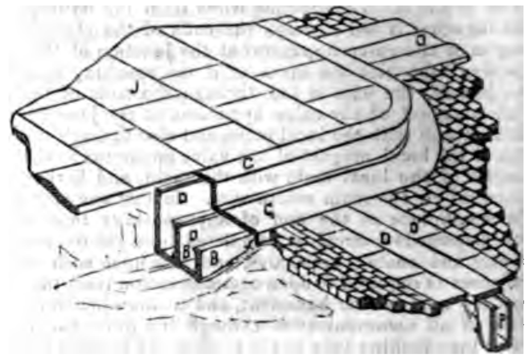
FIG. 1.



in the frames, E, by the spur wheels, G, and revolving motion is communicated to these rollers at the desired speed and in the direction of the arrows by the worm wheel, H, affixed upon one of their axes. These rollers, D, D, are adjustable in their distance from each other by means of the set screws, I, and spring, J, the set screws, J, being provided with lock nuts, K, to insure their remaining stationary. The action of this mechanism is as follows:—The end edge of the wire or other material, L, requiring to be covered or coated is first passed between the feeding rollers, D, and then introduced into the mouth of the central tube, A. The machinery being now set in motion, the feeding rollers, D, force the wire, L, down the tube, A, whilst the braiding spindles simultaneously cover or braid the same with textile or other material drawn off the bobbins, and if desirable to introduce yarn of textile material or lengths of india-rubber or other material to form an additional coating between such wire or central core and the outer braiding material, it is only requisite to employ a central guide piece, O, with holes surrounding the central opening, through which holes the additional coating material is guided in being *drawn off the creel or bobbins.*

1881.

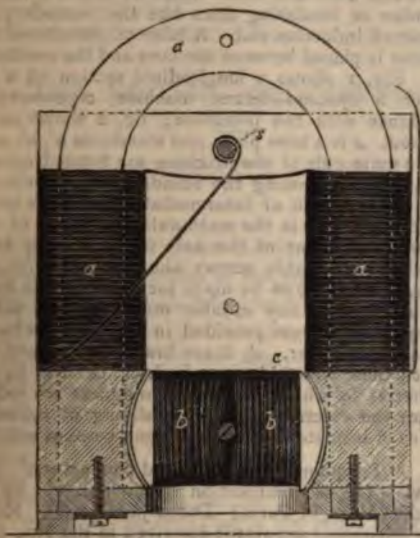
39. "Street curbs and gutters for the reception of telegraph wires." HERBERT JOHN HADDAN. (A communication from abroad by John D. Townsend, America.) Dated January 4. 4d. The object of the invention is to so construct the curbs and gutters of streets that the space now occupied by the ordinary curbstones and gutters may be utilised for the reception and preservation of telegraph, telephone, and other wires. J represents the pavement or sidewalk, C, C the curb, and G the gutter place or piece, cast in piece with the curb plates or pieces, C, C. The sides of the cases and cover are made with flanged projections, D and *f*. The flanges, D, receive the screws or bolts, E, by



means of which the cover is held in place, while the exterior flanges, *f*, serve to more effectually exclude dirt and moisture. The gutter plate, G, is provided with an exterior flange against which the paving stones are placed. At street crossings the space underneath the flagging will be occupied by the tranverse cases, P, which open into the main conduits, and may extend underneath the side walk to adjoining buildings, so as to carry the conductors directly into the buildings. These transverse conduits may be carried under the side walks at any point. The crosswalks are covered by the plates, O, having the flanges, *f*; the ordinary cross walk stones being shown at O'.

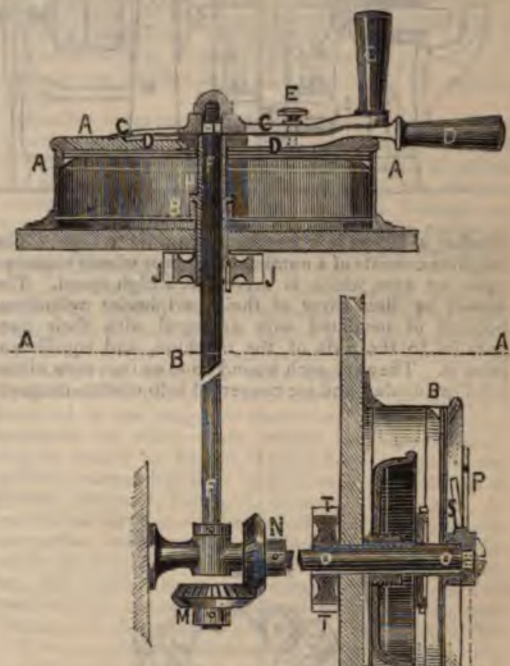
48. "Generating and utilising electricity for lighting," &c. W. R. LAKE. (A communication from abroad by Eugène Etève, of Paris.) Dated Jan. 4. 6d. Relates chiefly to that class of magneto-electric machines or apparatus, in which a coil or bobbin rotates before the poles of a magnet, and is designed to furnish a source of electricity which will in a small space develop a current sufficiently strong to produce light to actuate any apparatus, or to serve for igniting gases, essences, or volatile bodies, and thus to form an electric igniting apparatus. The invention also comprises improvements in apparatus for developing electric light. The apparatus consists of a horse-shoe magnet, *a*, composed of a suitable number of tempered and magnetised steel plates connected by one or more rivets; the arms of the said magnet are surrounded by a suitable number of layers of perfectly insulated copper wire. These arms carry at their ends two blocks or pieces of iron, forming open and recessed magnetic poles, between which a single coil, *b*, rotates. The said coil (mounted on an axle, *c*, and actuated by wheels), constitutes one of the essential features of the said invention, and its special characteristic is that it presents only two induction poles, and therefore only two points of resistance, whatever the power or size of

the machine may be. For the purpose of rendering this proportionately small coil sufficiently effective, the same is constructed of a varying number of plates, according to the power that is to be developed, the said plates being placed one above the other, and so connected as to form as it were a whole. The current developed in this coil is sent into two friction brushes



by means of a small commutator of ordinary construction. The wires are so arranged that the current produced by the rotation of the coil in the field of the magnet returns into the coils of the said magnet to increase its magnetism. This arrangement admits the use of magnets of inferior quality without risk of their demagnetisation.

56. "Mechanical telegraphs." WILLIAM CHADBURN. Dated Jan. 5. 6d. Relates to an arrangement of shafting in combination with bevelled wheels, and spur wheels, and indicator dials, and pointers, the combined arrangement constituting a mechanical telegraph for transmitting messages or orders, and replying to same, and is particularly applicable as a ship telegraph for transmitting messages from the bridge to the engine room or from the bridge to the steersman, or for other like purposes. The figure is a vertical sectional elevation of the instruments and operating gear. A is the transmitting instrument, and B the receiving instrument, the dials of which are identical, one section being devoted to "ahead," with the usual points "stand by," "slow," "half speed," "three quarters speed," "full speed," and the other section being devoted to "astern," with the usual points "stand by," "slow," "half speed," "full speed." The sections are separated from each other by the points "stop" and "revolutions." The "ahead" section is supplemented by two concentric series of numerals, one series representing units, and the other series representing tens. The dials of the instruments, A and B, being thus arranged, they are provided with two pointers, C and D, arranged to cover each other, and be held in such position by the pin, E, in the instrument, A, for ordinary working, when indicating "ahead" and "astern," and the ordinary indications only, and by removing the pin, E, to work separately when indicating revolutions; thus when the pin, E, is removed, one pointer may be *placed to stand* at the tens, say 60, and the other pointer may be placed at the units, say 5, thus showing 65 as the revolutions required. The essential feature of the invention is the way in which the transmitting instrument, A, is geared with the receiving instrument, B, so that whatever position the pointers, C, D, of the instrument, A, may be placed in, the pointers, S, P, of the instrument, B, would assume the same position. The gear consists in mounting the unit pointer and handle, D, of the transmitting instrument, A, upon a hollow shaft, boss, or sleeve, H, which is loosely mounted over the shaft, F, which carries the tens pointer and handle, C. The same arrangement is observed in the receiving instrument, B, namely, the unit pointer, S, is mounted upon the hollow shaft or sleeve, R, and the tens pointer, P, is mounted upon the central shaft or spindle, O. The connections are made by means of a duplicate system of shafting and bevel wheels, namely, the shaft, F, works the bevel wheels, M, which operates the bevel wheel, N, and the



shaft, O, and thus communicates motion from the tens pointer, C, of the instrument, A, to the tens pointer, P, of the instrument, B, and the hollow shaft, H, communicates motion to the toothed wheels, J, K, and to the shaft, L, which through the bevel wheels, W, X, the shaft, V, the toothed wheels, U, T, and the hollow shaft, R, communicates motion from the units pointer, D, of the instrument, A, to the units pointer, S, of the instrument B. It will be seen that the primary and terminal connections between the hollow shaft, H, and the hollow shaft, R, are made by means of the toothed wheels, J, K, and U, T. By the arrangement, the units and tens pointers may be worked independently of each other,

so as to be adapted for revolution indicators (or independent telegraphs, such as for working twin engines), or when fastened together by the pin, E, the pointers will all work conjointly, acting as an ordinary indicator, or, if desired, by placing a handle, as shown in dotted lines, on the pointer, P, of the instrument, B, the instruments and gear will act as a reply telegraph.

78. "Dynamo-electric machines for electric lighting." J. E. H. GORDON. Dated Jan. 6. 6d. Has for its object improvements in dynamo-electric machines for electric lighting. The improved dynamo-electric machine is designed to maintain a large number of independent lights; also so that the efficient working of the machine and the maintenance of the lights may not be interfered with by increasing or diminishing the number of lamps in operation from time to time. The machine consists of a number of discs or wheels mounted upon an axis, which is driven at a high speed. The wheels or discs carry at their peripheries cylindrical bobbins of insulated wire arranged with their axes parallel to the axis of the machine, and equidistant from it. They are each wound upon an iron core, either solid or tubular, and are converted into electro-magnets by permanent connection with a direct current exciting machine; the magnet coils may be combined in "series" or "quantity," or in whatever combination of them best suits the exciter used. The polarity of the magnets is *such that the poles* on each side of a given pole and *the one opposite to it* are of contrary polarity to itself.

FIG. 1.

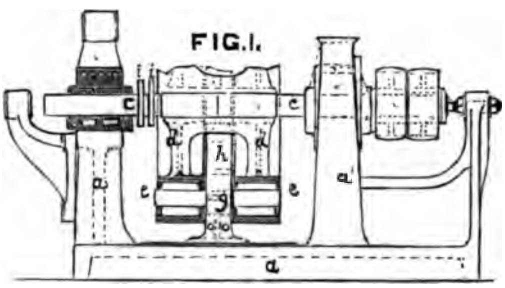
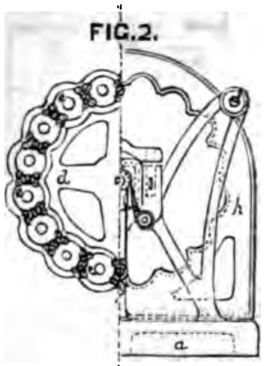


FIG. 2.



Between the wheels or discs other cylindrical bobbins of insulated wire are arranged, their axes are also parallel with the axis of the machine, and they are carried by stationary brackets fixed to the frame. They generally have cores, consisting preferably of a bundle of iron wires, though a slit tube might be used. When used for the production of high tension currents, such as are required for the inventor's iridium lamps, they are wound with fine wire. Each bobbin is divided by a number of insulating discs like the secondary of a Rhumkorff induction coil. A tube of ebonite or other insulator is placed between the core and the conducting wire. Fig. 1 shows a longitudinal section of a portion of a dynamo-electric machine, constructed in accordance with the invention; fig. 2 shows an end elevation. *a* is a base plate, and standards a^1, a^1, carrying the main axis of the machine are formed upon it; *b* is a stay connecting the standards, and serving to adjust the position of intermediate frames, as hereinafter described; *c* is the main axis, preferably of steel. Endway movement of the axis in its bearing is prevented by adjustable screws abutting upon its ends. Arrangements are to be made for rotating this axis at a high speed by any suitable motor, and to prevent heating, passages are provided in the bearings for the circulation of water. *d*, *d*, are brass wheels fixed upon axis, *c*; these wheels have cylindrical cavities in their peripheries in which the electro-magnets are lodged; *e*, *e*, are the electro-magnets consisting of cylindrical bobbins of insulated wire wound upon cores of soft iron.

93. "Telephonic apparatus and conductors." JOHN IMRAY. (A communication from abroad by Dr. Cornelius Herz, of Paris.) Dated Jan. 8. 6d. Relates to the telephonic apparatus described in the No. of the TELEGRAPHIC JOURNAL for March 1, 1881.

108. "Converting heat into electricity." JOHN CARTER RAMSDEN. Dated Jan. 8. 2d. This invention consists of appliances by means of which heat is converted into electricity and conducted so as to form one main current, or divided and subdivided, thereby admitting the application of the current or currents to one or more points, applications, and uses. Apparatus and means for purpose aforesaid comprise a furnace within which the spliced or contact parts of plates, rods, or bars of metal (by preference iron and copper) are received, the other ends of such plates, rods, or bars continuing and extending beyond or outside the furnace, the external portion of each plate, rod, or bar being enclosed by open ended cylinders, or tubes of porcelain or other non-conducting medium of electricity and resistant of high temperatures. To the outer extremities of the plates, rods, or bars is attached a bar of metal such as bismuth, or other metal adapted for conveying electricity, and to each of these plates, rods, or bars is attached a wire, each pair of wires being continued, and the circuit closed or completed by any of the ordinary appliances according to the use to which the electricity is to be applied. (*Provisional only.*)

152. "Electric batteries." JOHN ALEXANDER LUND. Dated Jan. 12. 2d. An electric battery is formed of a cell or vessel containing an acid solution (preferably sulphuric acid) and with zinc lying in mercury at the bottom of the vessel for the one element, whilst for the other is used plates formed of a mixture of oxide of manganese and carbon. The mixed oxide of manganese and carbon element employed is made up of a central carbon plate with one or more plates of mixed oxide of manganese and carbon held to it on one or more sides, the plates being formed so as only to touch one another at top and bottom. Electrodes formed in this way are now commonly made. (*Provisional only.*)

THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. IX.—No. 207.

THE BRITISH ASSOCIATION.

THE PRESIDENT'S ADDRESS.

THE address of Sir John Lubbock, Bart., the President of the Association for the year 1881, is in many respects a remarkable one, considering the number of subjects with which the author dealt. The progress of Electrical Science, from the important part which it plays at the present day, naturally came in for a fair share of attention. With reference to this subject, Sir John said: —

Electricity in the year 1831 may be considered to have just been ripe for its adaptation to practical purposes; it was but a few years previously, in 1819, that Oersted had discovered the deflective action of the current on the magnetic needle, that Ampère had laid the foundation of electro-dynamics, that Schweigger had devised the electric coil or multiplier, and that Sturgeon had constructed the first electro-magnet. It was in 1831 that Faraday—the prince of pure experimentalists—announced his discoveries of voltaic induction and magneto-electricity, which with the other three discoveries constitute the principles of nearly all the telegraph instruments now in use; and in 1834 our knowledge of the nature of the electric current had been much advanced by the interesting experiment of Sir Charles Wheatstone, proving the velocity of the current in a metallic conductor to approach that of the wave of light.

Practical applications of these discoveries were not long in coming to the fore, and the first telegraph line on the Great Western Railway from Paddington to West Drayton was set up in 1838. In America, Morse is said to have commenced to develop his recording instrument between the years 1832 and 1837, while Steinheil, in Germany, during the same period was engaged upon his somewhat super-refined ink-recorder, using for the first time the earth for completing the return circuit; whereas in this country Cooke and Wheatstone, by adopting the more simple device of the double-needle instrument, were the first to make the electric telegraph a practical institution. Contemporaneously with, or immediately succeeding these pioneers, we find in this country Alexander Bain, Breguet in France, Schilling in Russia, and Werner Siemens in Germany, the latter having first, in 1847, among others, made use of gutta-percha as an insulating medium for electric conductors, and thus cleared the way for subterranean and submarine telegraphy.

Four years later, in 1851, submarine telegraphy became an accomplished fact through the successful establishment of telegraphic communication between Dover and Calais. Submarine lines followed in rapid succession, crossing the English Channel and the German Ocean, threading their way through the Mediterranean, Black and Red Seas, until in 1866, after two abortive attempt, telegraphic communication was successfully established between the Old and New Worlds, beneath the Atlantic Ocean.

In connection with this great enterprise and with many investigations and suggestions of a highly scientific and important character, the name of Sir William Thomson will ever be remembered. The ingenuity displayed in perfecting the means of transmitting intelligence through metallic conductors, with the utmost despatch and certainty as regards the record obtained, between two points hundreds and even thousands of miles apart, is truly surprising. The instruments devised by Morse, Siemens, and Hughes have also proved most useful.

Duplex and quadruplex telegraphy, one of the most striking achievements of modern telegraphy—the result of the labours of several inventors—should not be passed over in silence. It not only serves for the simultaneous communication of telegraphic intelligence in both directions, but renders it possible for four instruments to be worked irrespectively of one another, through one and the same wire connecting two distant places.

Another more recent and perhaps still more wonderful achievement in modern telegraphy is the invention of the telephone and microphone, by means of which the human voice is transmitted through the electric conductor, by mechanism that imposes through its extreme simplicity. In this connection the names of Reiss, Graham Bell, Edison, and Hughes are those chiefly deserving to be recorded.

Whilst electricity has thus furnished us with the means of flashing our thoughts by record or by voice from place to place, its use is now gradually extending for the achievement of such quantitative effects as the production of light, the transmission of mechanical power, and the precipitation of metals. The principle involved in the magneto-electric and dynamo-electric machines, by which these effects are accomplished, may be traced to Faraday's discovery in 1831 of the induced current, but their realisation to the labours of Holmes, Siemens, Pacinotti, Gramme, and other. In the electric light, gas-lighting has found a formidable competitor, which appears destined to take its place in public illumination, and in lighting large halls, works, &c., for which purposes it combines brilliancy and freedom from obnoxious products of combustion, with comparative cheapness. The electric light seems also to threaten, when sub-divided in the manner recently devised by Edison, Swan, and others, to make inroads into our dwelling-houses.

By the electric transmission of power, we may hope some day to utilise at a distance such natural sources of energy as the Falls of Niagara, and to work our cranes, lifts, and machinery of every description by means of sources of power arranged at convenient centres. To these applications the brothers Siemens have more recently added the propulsion of trains by currents passing through the rails, the fusion in considerable quantities of highly refractory substances, and the use of electric centres of light in horticulture as proposed by Werner and William Siemens. By an essential improvement by Faure of the Planté Secondary Battery, the problem of storing electrical energy appears to have received a practical solution, the real importance of which is clearly proved by Sir W. Thomson's recent investigation of the subject.

It would be difficult to assign the limits to which this development of electrical energy may not be rendered serviceable for the purposes of man.

ADDRESS OF SIR WILLIAM THOMSON BEFORE THE PHYSICAL SCIENCE SECTION.

On the Sources of Energy in Nature Available to Man for the Production of Mechanical Effect.

DURING the fifty years' life of the British Association, the Advancement of Science for which it has lived and worked so well has not been more marked in any department than in one which belongs very decidedly to the Mathematical and Physical Section—the science of Energy. The very name energy, though first used in its present sense by Dr. Thomas Young about the beginning of this century, has only come into use practically after the doctrine which defines it had, during the first half of the British Association's life, been raised from a mere formula of mathematical dynamics to the position it now holds of a principle pervading all nature and guiding the investigator in every field of science.

A little article communicated to the Royal Society of Edinburgh, a short time before the commencement of the epoch of energy, under the title "On the Sources Available to Man for the Production of Mechanical Effect"* contained the following:—

"Men can obtain mechanical effect for their own purposes by working mechanically themselves and directing other animals to work for them, or by using natural heat, the gravitation of descending solid masses, the natural motions of water and air, and the heat, or galvanic currents, or other mechanical effects produced by chemical combination, but in no other way at present known. Hence the stores from which mechanical effect may be drawn by man belong to one or other of the following classes:—

"I. The food of animals.

"II. Natural heat.

"III. Solid matter found in elevated positions.

"IV. The natural motions of water and air.

"V. Natural combustibles (as wood, coal, coal-gas, oils, marsh-gas, diamond, native sulphur, native metals, meteoric iron).

"VI. Artificial combustibles (as smelted or electrically-deposited metals, hydrogen, phosphorus).

"In the present communication, known facts in natural history and physical science, with reference to the sources, from which these stores have derived their mechanical energies, are adduced to establish the following general conclusions:—

"*Heat radiated from the sun* (sunlight being included in the term) *is the principal source of mechanical effect available to man.*† From it is derived the whole mechanical effect obtained by means of animals working, water-wheels worked by rivers, steam-engines, galvanic engines, windmills, and the sails of ships.

"2. The motions of the earth, moon, and sun, and their mutual attractions, constitute an important source of available mechanical effect. From them all, but chiefly no doubt from the earth's motion of rotation, is derived the mechanical effect of water-wheels driven by the tides.

"3. The other known sources of mechanical effect available to man are either terrestrial—that is, belonging to the earth, and available without the influence of any external body—or meteoric—that is, belonging to bodies deposited on the earth from external space. Terrestrial sources, including mountain quarries and mines, the heat of hot springs, and the combustion of native sulphur, perhaps also the combustion of inorganic native combustibles, are actually used; but the mechanical effect obtained from them is very inconsiderable, compared with that which is obtained from sources belonging to the two classes mentioned above. Meteoric sources, including only the heat of newly-fallen meteoric bodies, and the combustion of meteoric iron, need not be reckoned among those available to man for practical purposes."

Thus we may summarise the natural sources of energy as tides, food, fuel, wind, and rain.

Among the practical sources of energy thus exhaustively enumerated, there is only one not derived from sun-heat—that is the tides. Consider it first. I have called it *practical*, because tide-mills exist. But the places where they can work usefully are very rare, and the whole amount of work actually done by them is a drop to the ocean of work done by other motors. A tide of two metres' rise and fall, if we imagine it utilised to the utmost by means of ideal water-wheels doing with perfect economy the whole work of filling and emptying a dock-basin in infinitely short times at the moment of high and low water, would give just one metre-ton per square metre of area. This work done four times in the twenty-four hours amounts to 1-1620th of the work of a horse-power. Parenthetically, in explanation, I may say that the French metrical equivalent (to which in all scientific and practical measurements we are irresistibly drawn, notwithstanding a dense barrier of insular prejudice most detrimental to the islanders)—the French metrical equivalent of James Watt's "horse-power" of 550 foot-pounds per second, or 33,000 foot-pounds per minute, or nearly two million foot-pounds per hour, is 75 metre-kilogrammes per second, or 4½ metre-tons per minute, or 270 metre-tons per hour. The French ton of 1,000 kilogrammes used in this reckoning is 0·984 of the British ton.

Returning to the question of utilising tidal energy, we find a dock area of 162,000 square metres (which is little more than 400 metres square) required for 100 horse-power. This, considering the vast costliness of dock construction, is obviously prohibitory of every scheme for economising tidal energy by means of artificial dock-basins, however near to the ideal perfection might be the realised tide-mill, and however convenient and non-wasteful the accumulator—whether Faure's electric accumulator, or other accumulators of energy hitherto invented or to be invented—which might be used to store up the energy yielded by the tide-mill during its short harvests about the times of high and low water, and to give it out when wanted at other times of six hours. There may, however, be a dozen places possible in the world where it could be advantageous to build a sea-wall across the mouth of a natural basin or estuary, and to utilise the tidal energy of filling it and emptying it by means of sluices and water-wheels. But if *so* much could be done, it would in many cases take only a little more to keep the water out altogether, and make fertile land of the whole basin. Thus we are led up to the interesting economical question, whether is forty acres (the British *agricultural* measure for the area of 162,000 square metres) or 100 horse-power more valuable. The annual cost of 100 horse-power night and day, for 365 days of the year, obtained through steam from coals, may be about ten times the rental of forty acres at £2 or £3 per acre. But the value of land is essentially much more than its rental, and the rental of land is apt to be much more

* Read at the Royal Society of Edinburgh on February 2nd, 1852 (*Proceedings* of that date).

† A general conclusion equivalent to this was published by Sir *John Herschel in 1833. See his Astronomy*, edit. 1849, § (399).

2 or £3 per acre in places where 100 horse-ould be taken with advantage from coal through

Thus the question remains unsolved, with the ity that in one place the answer may be *one l horse-power*, and in another *forty acres*. But, the question is hardly worth answering, con- the rarity of the cases, if they exist at all, mbankments for the utilisation of tidal energy :ticable.

.ng now to sources of energy derived from sun- : us take the wind first. When we look at the of British shipping and see 40,000 vessels, of ıbout 10,000 are steamers and 30,000 sailing nd when we think how vast an absolute amount :-power is developed by the engines of those s, and how considerable a proportion it forms vhole horse-power taken from coal annually in le world at the present time, and when we con- sailing ships of other nations, which must be d in the account, and throw in the little item of ls, we find that, even in the present days of scendency, old-fashioned Wind still supplies a rt of all the energy used by man. But however e may regret the time when Hood's young siting the fens of Lincolnshire at Christmas, ting to her dearest friend in London (both sixty ld now if they are alive), describes the delight g in a bower and looking over the wintry plain, plate, because "windmills lend revolving ani- to the scene," we cannot shut our eyes to the lamentable decadence of wind-power. Is this ce permanent, or may we hope that it is only ıry? The subterranean coal-stores of the world oming exhausted surely, and not slowly, and e of coal is upward bound—upward bound on ıle, though no doubt it will have its ups and n the future as it has had in the past, and as the case in respect to every marketable com-

When the coal is all burned; or, long before burned, when there is so little of it left and the ıes from which that little is to be excavated are nt and deep and hot that its price to the con is greatly higher than at present, it is most that windmills or wind-motors in some form in be in the ascendant, and that wind will do ıechanical work on land at least in proportion ıble to its present doing of work at sea.

now it is not utterly chimerical to think of wind ling coal in some places for a very important its present duty—that of giving light. Indeed, t we have dynamos and Faure's accumulator, want to let the thing be done is cheap wind- A Faure cell containing 20 kilogrammes of lead nium charged and employed to excite incan- vacuum-lamps, has a light-giving capacity of le hours (I have found considerably more in ıents made by myself; but I take 60 as a safe). The charging may be done uninjuriously, h good dynamical economy, in any time from rs to twelve or more. The drawing-off of the or use may be done safely, but somewhat waste- two hours, and very economically in any time five hours to a week or more. Calms do not en longer than three or four days at a time. , then, that a five days' storage-capacity suffices nay be a little steam-engine ready to set to any time after a four-days' calm, or the user ight may have a few candles or oil-lamps in and be satisfied with them when the wind fails e than five days). One of the 20-kilogramme ırged when the windmill works for five or six t any time, and left with its 60-candle hours' to be used six hours a day for five days, gives a 2-candle light. Thus thirty-two such accumulator cells soused would give as much light as four burners of London 16-candle gas. The probable cost of dynamo and accumulator does not seem fatal to the plan, if the windmill could be had for something comparable with the prime cost of a steam-engine capable of working at the same horse-power as the windmill when in good action. But windmills as hitherto made are very costly machines; and it does not seem probable that, without inventions not yet made, wind can be economically used to give light in any considerable class of cases, or to put energy into store for work of other kinds.

Consider, lastly, rain-power. When it is to be had in places where power is wanted for mills and factories of any kind, water-power is thoroughly appreciated. From time immemorial, water-motors have been made in large variety for utilising rain-power in the various conditions in which it is presented, whether in rapidly-flowing rivers, in natural waterfalls, or stored at heights in natural lakes or artificial reservoirs. Improvements and fresh inventions of machines of this class still go on; and some of the finest principles of mathematical hydrodynamics have, in the lifetime of the British Association, and, to a considerable degree, with its assistance, been put in requisition for perfecting the theory of hydraulic mechanism and extending its practical applications.

A first question occurs: Are we necessarily limited to such natural sources of water-power as are supplied by rain falling on hill-country, or may we look to the collection of rain-water in tanks placed artificially at sufficient heights over flat country to supply motive-power economically by driving water-wheels? To answer it: Suppose a height of 100 metres, which is very large for any practicable building, or for columns erected to support tanks; and suppose the annual rainfall to be three-quarters of a metre (30 inches). The annual yield of energy would be 75 metre-tons per square metre of the tank. Now one horse-power for 365 times 24 hours is 236,500 foot-tons; and therefore (dividing this by 75) we find 3,153 square metres as the area of our supposed tank required for a continuous supply of one horse-power. The prime cost of such a structure, not to speak of the value of the land which it would cover, is utterly prohibitory of any such plan for utilising the motive power of rain. We may or may not look forward hopefully to the time when windmills will again "lend revolving animation" to a dull flat country; but we certainly need not be afraid that the scene will be marred by forests of iron columns taking the place of natural trees, and gigantic tanks overshadowing the fields and blackening the horizon.

To use rain-power economically on any considerable scale we must look to the natural drainage of hill country, and take the water where we find it either actually falling or stored up and ready to fall when a short artificial channel or pipe can be provided for it at moderate cost. The expense of aqueducts, or of underground water-pipes, to carry water to any great distance—any distance of more than a few miles or a few hundred yards—is much too great for economy when the yield to be provided for is *power*; and such works can only be undertaken when the *water itself* is what is wanted. Incidentally, in connection with the water supply of towns, some part of the energy due to the head at which it is supplied may be used for power. There are, however, but few cases (I know of none except Greenock) in which the energy to spare over and above that devoted to bringing the water to where it is wanted, and causing it to flow fast enough for convenience at every opened tap in every house or factory, is enough to make it worth while to make arrangements for letting the water-power be used

without wasting the water-substance. The cases in which water-power is taken from a town supply are generally very small, such as working the bellows of an organ, or "hair-brushing by machinery," and involve simply throwing away the used water. The cost of energy thus obtained must be something enormous in proportion to the actual quantity of the energy, and it is only the smallness of the quantity that allows the convenience of having it when wanted at any moment, to be so dearly bought.

For anything of great work by rain-power, the water-wheels must be in the place where the water supply with natural fall is found. Such places are generally far from great towns, and the time is not yet come when great towns grow by natural selection beside waterfalls, for power; as they grow beside navigable rivers, for shipping. Thus hitherto the use of water-power has been confined chiefly to isolated factories which can be conveniently placed and economically worked in the neighbourhood of natural waterfalls. But the splendid suggestion made about three years ago by M. Siemens in his presidential address to the Institution of Mechanical Engineers, that the power of Niagara might be utilised, by transmitting it electrically to great distances, has given quite a fresh departure for design in respect to economy of rain-power. From the time of Joule's experimental electro-magnetic engines developing 90 per cent. of the energy of a Voltaic battery in the form of weights raised, and the theory of the electro-magnetic transmission of energy completed thirty years ago on the foundation afforded by the train of experimental and theoretical investigations by which he established his dynamical equivalent of heat in mechanical, electric, electro-chemical, chemical, electro-magnetic, and thermo-electric phenomena, it had been known that potential energy from any available source can be transmitted electro-magnetically by means of an electric current through a wire, and directed to raise weights at a distance, with unlimitedly perfect economy. The first large-scale practical application of electro-magnetic machines was proposed by Holmes in 1854, to produce the electric light for lighthouses, and persevered in by him till he proved the availability of his machine to the satisfaction of the Trinity House and the delight of Faraday in trials at Blackwall in April, 1857, and it was applied to light the South Foreland lighthouse on December 8, 1858. This gave the impulse to invention; by which the electro-magnetic machine has been brought from the physical laboratory into the province of engineering, and has sent back to the realm of pure science a beautiful discovery—that of the fundamental principle of the dynamo, made triply and independently, and as nearly as may be simultaneously, in 1867 by Dr. Werner Siemens, Mr. S. A. Varley, and Sir Charles Wheatstone; a discovery which constitutes an electro-magnetic analogue to the fundamental electrostatic principle of Nicholson's revolving doubler, resuscitated by Mr. C. F. Varley in his instrument "for generating electricity," patented in 1860; and by Holtz in his celebrated electric machine; and by myself in my "replenisher" for multiplying and maintaining charges in Leyden jars for heterostatic electrometers, and in the electrifier for the siphon of my recorder for submarine cables.

The dynamos of Gramme and Siemens, invented and made in the course of these fourteen years since the discovery of the fundamental principle, give now a ready means of realising economically on a large scale, for many important practical applications, the old thermo-dynamics of Joule in electro-magnetism; and, what particularly concerns us now in connection with *my present subject*, they make it possible to transmit *electro-magnetically* the work of waterfalls through long insulated conducting wires, and use it at distances of fifties or hundreds of miles from the source, with excellent economy—better economy, indeed, in respect to proportion of energy used to energy dissipated than almost anything known in ordinary mechanics and hydraulics for distances of hundreds of yards instead of hundreds of miles.

In answer to questions put to me in May, 1879,* by the Parliamentary Committee on Electric Lighting, I gave a formula for calculating the amount of energy transmitted, and the amount dissipated by being converted into heat on the way, through an insulated copper conductor of any length, with any given electromotive force applied to produce the current. Taking Niagara as example, and with the idea of bringing its energy usefully to Montreal, Boston, New York, and Philadelphia, I calculated the formula for a distance of 300 British statute miles (which is greater than the distance of any of those four cities from Niagara, and is the radius of a circle covering a large and very important part of the United States and British North America), I found almost to my surprise that, even with so great a distance to be provided for, the conditions are thoroughly practicable with good economy, all aspects of the case carefully considered. The formula itself will be the subject of a technical communication to Section A in the course of the Meeting on which we are now entering. I therefore, at present, restrict myself to a slight statement of results :—

1. Apply dynamos driven by Niagara to produce a difference of potential of 80,000 volts between a good earth-connection and the near end of a solid copper wire of half an inch (1·27 centimetre) diameter, and 300 statute miles (483 kilometres) length.

2. Let resistance by driven dynamos doing work, or by electric lights, or, as I can now say, by a Faure battery taking in a charge, be applied to keep the remote end at a potential differing by 64,000 volts from a good earth-plate there.

3. The result will be a current of 240 webers through the wire taking energy from the Niagara end at the rate of 26,250 horse-power, losing 5,250 (or 20 per cent.) of this by the generation and dissipation of heat through the conductor and 21,000 horse-power (or 80 per cent. of the whole) on the recipients at the far end.

4. The elevation of temperature above the surrounding atmosphere, to allow the heat generated in it to escape by radiation and be carried away by convection is only about 20° Centigrade; the wire being hung freely exposed to air like an ordinary telegraph wire supported on posts.

5. The striking distance between flat metallic surfaces with difference of potentials of 80,000 volts (or 75,000 Daniells) is (Thomson's "Electrostatics and Magnetism," § 340) only 18 millimetres, and therefore there is no difficulty about the insulation.

6. The cost of the copper wire, reckoned at 8d. per lb., is £37,000; the interest on which at 5 per cent. is £1,900 a year. If 5,250 horse-power at the Niagara end costs more than £1,900 a year, it would be better economy to put more copper into the conductor; if less, less. I say no more on this point at present, as the economy of copper for electric conduction will be the subject of a special communication to the Section.

I shall only say, in conclusion, that one great difficulty in the way of economising the electrical transmitting power to great distances (or even to moderate distances of a few kilometres) is now overcome by Faure's splendid invention. High potential—as Siemens, I believe, first pointed out—is the essential for

* Printed in the Parliamentary Blue Book Report of the Committee on Electric Lighting, 1879.

good dynamical economy in the electric transmission of power. But what are we to do with 80,000 volts when we have them at the civilised end of the wire? Imagine a domestic servant going to dust an electric lamp with 80,000 volts on one of its metals! Nothing above 200 volts ought on any account ever to be admitted into a house or ship, or other place where safeguards against accident cannot be made absolutely and for ever trustworthy against all possibility of accident. In an electric workshop 80,000 volts is no more dangerous than a circular saw. Till I learned Faure's invention I could but think of step-down dynamos, at a main receiving station, to take energy direct from the electric main with its 80,000 volts, and supply it by secondary 200-volt dynamos or 100-volt dynamos, through proper distributing wires, to the houses and factories and shops where it is to be used for electric lighting, and sewing-machines, and lathes, and lifts, or whatever other mechanism wants driving power. Now the thing is to be done much more economically, I hope, and certainly with much greater simplicity and regularity, by keeping a Faure battery of 40,000 cells always being charged direct from the electric main, and applying a methodical system of removing sets of 50, and placing them on the town-supply circuits, while other sets of 50 are being regularly introduced into the great battery that is being charged, so as to keep its number always within 50 of the proper number, which would be about 40,000 if the potential at the emitting end of the main is 80,000 volts.

ADDRESS OF SIR W. ARMSTRONG, BEFORE THE MECHANICAL SCIENCE SECTION.

WITH reference to electricity, Sir William adverted to the question whether we may hope to evade the difficulties of the steam engine, as regards waste of power, by resorting to electrical methods of obtaining power. With regard to this important question, most people, he said, especially those who are least competent to judge, look to electricity as the coming panacea for all mechanical deficiency, and certainly the astonishing progress of electricity as applied to telegraphy, and to those marvellous instruments of recent invention which the British Post-Office claims to include in its monopoly of the electric telegraph, as well as the wonderful advance which electricity has made as an illuminating agent, does tend to impress us with faith in its future greatness in the realm of motive power as well. The difference between heat and electricity in their modes of mechanical action is very wide. Heat acts by expansion of volume, which we know to be a necessarily wasteful principle, while electricity operates by attraction and repulsion, and thus produces motion in a manner which is subject to no greater loss of effect than attends the motive action of gravity, as exemplified in the ponderable application of falling water in hydraulic machines. If then, we could produce electricity with the same facility and economy as heat, the gain would be enormous, but this, as yet at least, we cannot do. At present by far the cheapest method of generating electricity is by the dynamic process. Instead of beginning with electricity to produce power, we begin with power to produce electricity. As a secondary motor, an electric engine may, and assuredly will, play an important part in future applications of power, but our present inquiry relates to a primary and not a secondary employment of electricity. Thus we are brought to the question, from what source, other than mechanical action, can we hope to obtain a supply of electricity sufficiently cheap and abundant to enable it to take the place of heat as a motive energy. It is commonly said that we know so little of the nature of electricity that it is impossible to set bounds to the means of obtaining it, but ignorance is at least as liable to mislead in the direction of exaggerated expectation as in that of incredulity. It may be freely admitted that the nature of electricity is much less understood than that of heat, but we know that the two are very nearly allied. The doctrine that heat consists of internal motion of molecules may be accepted with almost absolute certainty of its truth. The old idea of heat being a separate entity is no longer held, except by those who prefer the fallacious evidence of their senses to the demonstrations of science. So, also, the idea of electricity having a separate existence from tangible matter must be discarded; and we are justified in concluding that it is merely a strained or tensional condition of the molecules of matter. Although electricity is more prone to pass into heat than heat into electricity, yet we know that they are mutually convertible. In short, I need scarcely remind you that, according to that magnificent generalisation of modern times, so pregnant with great consequences, and for which we are indebted to many illustrious investigators, we now know that heat, electricity, and mechanical action are all equivalent and transposable forms of energy, of which motion is the essence. To take a cursory view of our available sources of energy, we have firstly the direct heating power of the sun's rays, which as yet we have not succeeded in applying to motive purposes. Secondly, we have water-power, wind-power, and tidal-power, all depending upon influences lying outside of our planet. And, thirdly, we have chemical attraction or affinity. Beyond these there is nothing worth naming. Of the radiant heat of the sun I shall have to speak hereafter, and bearing in mind that we are in search of electricity as a cause and not an effect of motive power, we may pass over the dynamical agencies comprised under the second head, and direct our attention to chemical affinity as the sole remaining source of energy available for our purpose. At present we derive motive power from chemical attraction through the medium of heat only, and the question is, can we with advantage draw upon the same source through the medium of electricity? The process by which we obtain our supply of heat from the exercise of affinity is that of combustion, in which the substances used consist, on the one hand, of those we call fuel, of which coal is the most important, and on the other, of oxygen, which we derive from the atmosphere. The oxygen has an immense advantage over every other available substance in being omnipresent and costless. The only money value involved is that of the fuel, and in using coal we employ the cheapest oxidisable substance to be found in nature. Moreover, the weight of coal used in the combination is only about one-third the weight of oxygen, so that we only pay upon one-fourth of the whole material consumed. Thus we have conditions of the most favourable description for the production of energy, in the form of heat, and if we could only use the affinities of the same substances with equal facility to evolve electric energy instead of heat energy there would be nothing more to desire; but as yet there is no appearance of our being able to do this. According to our present practice we consume zinc, instead of coal, in the voltaic production of electricity, and not only is zinc 30 or 40 times dearer than coal, but it requires to be used in about six-fold larger quantity in order to develop an equal amount of energy.

Some people are bold enough to say that, with our present imperfect knowledge of electricity, we have no right to condemn all plentiful substances other than coal as impracticable substitutes for metallic zinc, but it is manifest that we cannot get energy from affinity where affinity has already been satisfied. The numerous bodies which constitute the mass of our globe, and which we call earths, are bodies in this inert condition. They have already, by the union of the two elements composing them, evolved the energy due to combination, and that energy has ages ago been dissipated in space in the form of heat, never again to be available to us. As well might we try to make fire with ashes as to use such bodies over again as sources of either heat or electricity. To make them fit for our purpose we should first have to annul their state of combination, and this would require the expenditure of more energy upon them than we could derive from their recombination. Water, being oxydised hydrogen, must be placed in the same category as the earths. In short, the only abundant substances in nature possessing strong unsatisfied affinities are those of organic origin, and in the absence of coal, which is the accumulated product of a past vegetation, our supply of such substances would be insignificant. This being the case, until a means be found of making the combination of coal with oxygen directly available for the development of electric energy, as it now is of heat energy, there seems to be no probability of our obtaining electricity from chemical action at such a cost as to supplant heat as a motive agent. Sir W. Armstrong then discussed the transmutation of heat economically into the more available form of electricity, and continued--It is only the want of an efficient apparatus for converting heat into electricity that prevents our using the direct heating action of the sun's rays for motive power. In our climate, it is true, we shall never be able to depend upon sunshine for power, nor need we repine on that account so long as we have the preserved sunbeams which we possess in the condensed and portable form of coal, but in regions more favoured with sun and less provided with coal the case would be different. The actual power of the sun's rays is enormous, being computed to be equal to melting a crust of ice 103 feet thick over the whole earth in a year. Within the tropics it would be a great deal more, but a large deduction would everywhere have to be made for absorbtion of heat by the atmosphere. Taking all things into account, however, we shall not be far from the truth in assuming the solar heat in that part of the world to be capable of melting annually, at the surface of the ground, a layer of ice 85 feet thick. Now let us see what this means in mechanical effect. To melt 1 lb. of ice requires 142·4 English units of heat, which multiplied by 772 gives us 109,932 foot pounds as the mechanical equivalent of the heat consumed in melting a pound of ice. Hence we find that the solar heat operating upon an area of one acre in the tropics, and competent to melt a layer of ice 85 feet thick in a year, would, if fully utilised, exert the amazing power of 4,000 horses acting for nearly nine hours every day. In dealing with the sun's energy we could afford to be wasteful. Waste of coal means waste of money and premature exhaustion of coal beds. But the sun's heat is poured upon the earth in endless profusion—endless, at all events, in a practical sense, for whatever anxiety we may feel as to the duration of coal, we need have none as to the duration of the sun. We have therefore only to consider whether we can divert to our use so much of the sun's motive energy as will repay the cost of the necessary apparatus, and whenever such an apparatus is forthcoming we may expect to bring into subjection a very considerable proportion of the 4,000 *invisible* horses which science tells us are to be found within every acre of tropical ground. But what be the future of electricity as a prime mover, a dominant or subordinate relation to heat, it to be largely used for mechanical purposes in ary capacity, that is to say, as the offspring i the parent of motive power. The most distincti teristic of electricity is that which we express by "current," and this gives it great value in cas power is required in a transmissible form. may be objected to as implying a motion or tr analogous to the flow of a liquid through a pipe the passage of electricity through a conducto regarded as a wave-like action communica particle to particle. In the case of a fluid through a pipe, the resistance to the flow inc the square of the velocity, while in the ca electric current the resistance through a gi ductor is a constant proportion of the ener mitted. So far, therefore, as resistance is c electricity has a great advantage over wat transmission of power. The cost of the condu however, be a grave consideration where the great, because its section must be increased in tion to the length to keep the resistance the s must also be large enough in section to prevent which not only represents loss, but impairs tivity. To work advantageously on this s high electro-motive force must be used, and involve loss by imperfect insulation, incre amount with the length of the line. For these there will be a limit to the distance to which e may be profitable conveyed, but within that lir will be wide scope for its employment transn Whenever the time arrives for utilising the great waterfalls the transmission of power by e will become a system of vast importance. E small streams of water inconveniently situ direct application, may, by the adoption principle, be brought into useful operation. I motive purposes, also, we find the dynam principle to be available, as instanced in interesting example presented in Siemens railway, which has already attained that of success which generally foreshadows portant future. It forms a combined fixed and locomotive system of traction, th engine being the generator of the power electric engine representing the locomotive. power may both be transmitted and dis by the intervention of electricity; but it will under great disadvantage when thus applied, thoroughly reflective electric accumulator be p capable of giving out electric energy with aln limited rapidity. How far the secondary ba M. Faure will fulfil the necessary conditions re be seen, and it is to be hoped that the dis which may be expected to take place at this m the British Association will enable a just est its capabilities to be formed. The introductic Faure battery is at any rate a very important electrical progress. It will enable motors power, whatever their nature may be, to ac by uninterrupted action the effect of muc machines acting for short periods, and by thi the value of very small streams of water will b enhanced. This will be especially the case w power of the stream is required for electric which, in summer, when the springs are low, be required during the brief hours of darkness, winter the longer nights will be met by abundant supply of water. Even the fitful p wind, now so little used, will probably acquire when aided by a system which will not only

ıalise, the variable and uncertain power exerted air. It would greatly add to the utility of the battery if its weight and size could be conly reduced, for in that case it might be applicable y purposes of locomotion. We may easily con:s becoming available in a lighter form for all carriages on common roads, thereby saving to extent the labour of horses. Even the nobler that strides a bicycle, or the one of fainter : that prefers the safer seat of a tricycle, may g be spared the labour of propulsion, and the ıay not be distant when an electric horse far menable to discipline than the living one may ed to the bounteous gifts which science has :d on civilized man.

ELECTRIC ENERGY.

By Dr. C. W. SIEMENS, F.R.S.

.d before the British Association, September, 1881.)

ıst of March, 1880, I communicated to the Society a paper "On the Influence of Electric pon Vegetation, &c.," in which I arrived at the on that electric light was capable of producing ants effects comparable to those of solar radiahat chlorophyl was produced by it, and that and fruit rich in aroma and colour could be ed by its aid. My experiments also went to hat plants do not as a rule require a period of ing the 24 hours of the day, but make increased orous progress if subjected in winter time to ;ht during the day and to electric light during ht. During the whole of last winter I conmy experiments on an enlarged scale, and it is sent purpose to give a short account of these .ents and of some further applications of energy to farming operations (including the g of water, the sawing of timber, and chaff and ting) at various distances not exceeding half a ım the source of power, giving useful employluring the daytime to the power-producing :ry, and thus reducing indirectly the cost of the ring the night-time. The arrangement consists gh pressure steam engine of six horse-power l, supplied by Messrs. Tangye Brothers, which ıotion to two dynamo machines (Siemens D) ed separately to two electric lamps each capable ing a light of about 4,000 candle-power. One : lamps was placed inside a glasshouse of 2,318 et capacity, and the other was suspended at a of 12 to 14 feet over some sunk greenhouses. ste steam of the engine was condensed in a whence the greenhouses take their circulating of hot water, thus saving the fuel that would e be required to heat the stoves. The experivere commenced on the 23rd of October, 1880, re continued till the 7th of May, 1881. The plan of operation consisted in lighting the lights at first at six o'clock and during the short five o'clock, every evening except Sunday, contheir action until dawn. The outside light was d by a clear gas lantern, while the light inside e was left naked in the earlier experiments, one bjects being to ascertain the relative effect of t under these two conditions. The inside light was placed at one side over the entrance into the house, in front of a metallic reflector to save the rays that would otherwise be lost to the plants inside the house. The house was planted in the first place with peas, French beans, wheat, barley, and oats, as well as with cauliflowers, strawberries, raspberries, peaches, tomatoes, vines, and a variety of flowering plants, including roses, rhododendrons, and azaleas. All these plants being of a comparatively hardy character, the temperature in this house was maintained as nearly as possible at 60 deg. Fahr. The early effects observed were anything but satisfactory. While under the influence of the light suspended in the open air over the sunk houses the beneficial effects due to the electric light observed during the previous winter repeated themselves, but the plants in the house with the naked electric light soon manifested a withered appearance. Was this result the effect of the naked light, or was it the effect of the chemical products—nitrogenous compounds and carbonic acid—which are produced in the electric arc? Proceeding on the first-named assumption, and with a view of softening the ray of the electric arc, small jets of steam were introduced into the house through tubes, drawing in atmospheric air with the steam, and producing the effects of clouds interposing themselves in an irregular fashion between the light and the plants. This treatment was decidedly beneficial to the plants, although care had to be taken not to increase the amount of moisture thus introduced beyond certain limits. As regards the chemical products—carbonic and nitrogenous compounds—it was thought that these would prove rather beneficial than otherwise in furnishing the very ingredients upon which plant life depends, and, further, that the constant supply of pure carbonic acid resulting from the gradual combustion of the carbon electrodes, might render a diminution in the supply of fresh air possible, and thus lead to economy of fuel. The plants did not, however, take kindly to these innovations in their mode of life, and it was found necessary to put a lantern of clear glass round the light, for the double purpose of discharging the chemical products of the arc and of interposing an effectual screen between the arc and the plants under its influence. The effect of interposing a mere thin sheet of clear glass between the plants and the source of electric light was most striking. On placing such a sheet of clear glass so as to intercept the rays of the electric light from a portion only of a plant—for instance, a tomato plant—it was observed that in the course of a single night the line of demarcation was most distinctly shown upon the leaves. The portion of the plant under the direct influence of the naked electric light, though at a distance from it of nine to ten feet, was distinctly shrivelled, whereas that portion under cover of the clear glass continued to show a healthy appearance, and this line of demarcation was distinctly visible on individual leaves. Not only the leaves, but the young stems of the plants soon showed signs of destruction when exposed to the naked electric light, and these destructive influences were perceptible, though in a less marked degree, at a distance of 20 ft. from the source of light. A question here presents itself that can hardly fail to excite the interest of the physiological botanist. The clear glass does not apparently intercept any of the luminous rays, which cannot therefore be the cause of the destructive action. Professor Stokes has shown, however, in 1853, that the electric arc is particularly rich in highly refrangible invisible rays, and that these are largely absorbed in their passage through clear glass, it therefore appears reasonable to suppose that it is those highly refrangible rays beyond the visible spectrum that work destruction on vegetable cells, thus contrasting with the

luminous rays of less refrangibility, which, on the contrary, stimulate their organic action. Being desirous to follow up this inquiry a little further, I sowed a portion of the ground in the experimental conservatory with mustard and other quick-growing seeds, and divided the field into equal radial portions by means of a framework, excluding diffused light, but admitting light at equal distances from the electric arc. The first section was under the action of the naked light, the second was covered with a pane of clear glass, the third with yellow glass, the fourth with red, and the fifth with blue glass. The relative progress of the plants was noted from day to day, and the differences of effect upon the development of the plants were sufficiently striking to justify the following conclusions:—Under the clear glass the largest amount of and most vigorous growth was induced; the yellow glass came next in order, but the plants, though nearly equal in size, were greatly inferior in colour and thickness of stem to those under the clear glass; the red glass gives rise to lanky growth and yellowish leaf; while the blue glass produces still more lanky growth and sickly leaf. The uncovered compartment showed a stunted growth, with a very dark and partly shrivelled leaf. It should be observed that the electric light was kept on from 5 p.m. till 6 a.m. every night except Sundays during the experiment, which took place in January, 1881, but that diffused daylight was not excluded during the intervals; also that circulation of air through the dividing framework was provided for. These results are confirmatory of those obtained by Dr. J. W. Draper (see "Scientific Memoirs" by J. W. Draper, M.D., LL.D., Memoir X.) in his valuable researches on plant production in the solar spectrum in 1843 which led him to the conclusion, in opposition to the then prevailing opinion, that the yellow ray, and not the violet ray, was most efficacious in promoting the decomposition of carbonic acid in the vegetable cell. Having in consequence of these preliminary inquiries determined to surround the electric arc with a clear glass lantern, more satisfactory results were soon observable. Thus peas which had been sown at the end of October produced a harvest of ripe fruit on the 16th of February, under the influence, with the exception of Sunday nights, of continuous light. Raspberry stalks put into the house on the 16th of December produced ripe fruit on the 1st of March, and strawberry plants put in about the same time produced ripe fruit of excellent flavour and colour on the 14th of February. Vines which broke on the 26th of December produced ripe grapes of stronger flavour than usual on the 10th of March. Wheat, barley, and oats shot up with extraordinary rapidity under the influence of continuous light, but did arrive at maturity; their growth having been too rapid for their strength caused them to fall to the ground after having attained the height of about 12 inches. Seeds of wheat, barley, and oats planted in the open air and grown under the influence of the external electric light produced, however, more satisfactory results; having been sown in rows on the 6th of January, they germinated with difficulty on account of frost and snow on the ground, but developed rapidly when milder weather set in, and showed ripe grain by the end of June, having been aided in their growth by the electric light until the beginning of May. Doubts have been expressed by some botanists whether plants grown and brought to maturity under the influence of continuous light would produce fruit capable of reproduction; and in order to test this question, the peas gathered on the 16th of February from the plants which had been grown under almost continuous light action were replanted on the 18th of February. They vegetated in a few days, showing every appearance of healthy growth. Further evidence on the same question will be obtained by Dr. Gilbert, F.R.S., who has undertaken to experiment upon the wheat, barley, and oats grown as above stated, but still more evidence will probably be required before all doubt on the subject can be allayed. I am aware that the great weight of the opinion of Mr. Darwin goes in favour of the view that many plants, if not all of them, require diurnal rest for their normal development, and it is with great diffidence, and without wishing to generalise, that I feel bound to state as the result of all my experiments, extending now over two winters, that although periodic darkness evidently favours growth in the sense of elongating the stalks of plants, the continuous stimulus of light appears favourable for healthy development at a greatly accelerated pace through all the stages of the annual life of the plant, from the early leaf to the ripened fruit. The latter is superior in size, aroma, and in colour to that produced by alternating light, and the resulting seeds are not, at any rate, devoid of regerminating power. Further experiments are necessary, I am aware, before it would be safe to generalise, nor does this question of diurnal rest in any way bear upon that of annual or winter rest, which probably most plants, that are not so-called annuals, do require. The beneficial influence of the electric light has been very manifest upon a banana palm, which at two periods of its existence—viz., during its early growth and at the time of the fruit development, was placed (in February and March of 1880 and 1881) under the night action of one of the electric lights, set behind glass at a distance not exceeding two yards from the plant. The result was a bunch of fruit weighing 75 lbs., each banana being of unusual size, and pronounced by competent judges to be unsurpassed in flavour. Melons also remarkable for size and aromatic flavour have been produced under the influence of continuous light in the early spring of 1880 and 1881, and I am confident that still better results may be realised when the best conditions of temperature and of proximity to the electric light have been thoroughly investigated. My object hitherto has rather been to ascertain the general conditions necessary to promote growth by the aid of electric light than the production of quantitative results; but I am disposed to think that the time is not far distant when the electric light will be found a valuable adjunct to means at the disposal of the horticulturist in making him really independent of climate and season, and furnishing him with a power of producing new varieties. Before electro horticulture can be entertained as a practical process it would be necessary, however, to prove its cost, and my experiments of last winter have been in part directed towards that object. Where water-power is available the electric light can be produced at an extremely moderate cost, comprising carbon electrodes, and wear and tear of and interest upon apparatus and machinery employed, which experience elsewhere has already shown to amount to 6d. per hour for a light of 5,000 candles. The personal current attention requisite in that case consists simply in replacing the carbon electrodes every six or eight hours, which can be done without appreciable expense by the under gardener in charge of the fires of the greenhouses. In my case no natural source of power was available, and a steam-engine had to be resorted to. The engine, of six nominal horse-power which I employ to work the two electric lights of 5,000 candle-power each consumes 56 lbs. of coal per hour (the engine being of the ordinary high-pressure type), which taken at 20s. a ton, would amount to 6d. or to 3d. per light of 5,000 candles.

(To be continued.)

THE PARIS ELECTRICAL EXHIBITION.

THE BRITISH SECTION.

ALFRED APPS.

MR. ALFRED APPS, of 433, Strand, exhibits the large induction coil (shown by the figure), constructed for Mr. W. Spottiswoode, F.R.S.

For a full description of this fine instrument, se e TELEGRAPHIC JOURNAL, July 1st, 1877.

JOSEPH BOURNE AND SON.

Messrs. Joseph Bourne & Son, of the Denby Pottery, near Derby, display a large collection of porcelain insulators, battery cells, &c. The principal forms shown are those indicated by the figures.

The peculiar qualities resulting from the composition of the paste from which the insulators are made are, a high degree of vitrefaction, combined with great toughness and strength. These qualities have led—since the commencement of the manufacture thirty years ago—to a large and increasing demand for the ware.

For many years Messrs. Bourne enjoyed the exclusive right to manufacture the well-known double V insulators patented by Mr. Varley, whilst those and other shapes—notably the Z pattern—have been largely supplied to the English Government Telegraph Department.

The larger insulators exhibited are copies of the designs of colonial and foreign engineers who look for strength and durability as well as perfect insulation for long distances; whilst the smaller specimens have been found equally adapted to telephone and mining purposes.

The peculiar qualities, before specified, of the ware also enter into the composition of the battery cells exhibited.

RICHARD JOHNSON AND NEPHEW.

Messrs. Richard Johnson and Nephew, of the Bradford Iron Works, Manchester, show the following specimens of iron wire manufactured by them more especially for telegraphic purposes :—

No. O O B W G best galvanised iron rod for cable armour. The special feature of this specimen is its great length, the sample being made in one piece, without weld or joint, it is thus of great value for cable making, as welding is minimised, and therefore weak places are comparatively few. This coil weighs over 200 lbs.

No. 8 B W G, galvanised telegraph wire of low electrical resistance. This meets in every respec' the special requirements of the British Post Offic' authorities and their specifications, and can manufactured in lengths of single pieces, 140 lbs. each.

No. 16 3 strand galvanised telegraph wire is also prepared to meet the British Post Office authorities' specification and requirements in every respect.

No. 11 galvanised special telephone wire is prepared expressly for telephone work, and can be made in single pieces up to 140 lbs. if so required; and from what has already been experienced in the erection of telephone lines it has satisfactorily filled every requirement.

No. 15 galvanised special telephone wire of a high breaking strain. The same remarks are ap-

plicable to this as to the No. 11, with the exception that the No. 15 is prepared for erection in towns and cities where appearance and light supports are wanted, and where an increased strength is required as a margin of safety to prevent lines breaking down and falling across streets.

THE EXCHANGE TELEGRAPH COMPANY.

The Exchange Telegraph Company will exhibit at the exhibition an improved fire-alarm telegraph. This apparatus has been constructed with a view to obviate the necessity for skilled supervision of its working and to remove the chief objections to the existing systems.

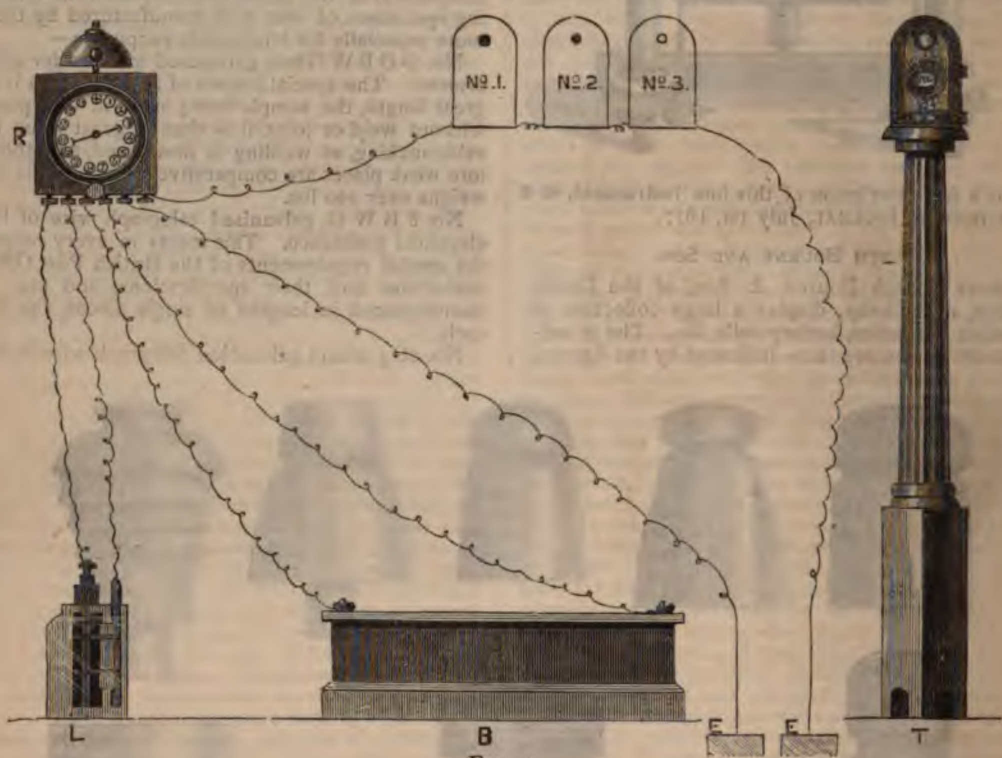


FIG. 1.

It has been found in practice that numerous pieces of telegraphic apparatus at the receiving station, however perfect they may be in themselves, tend to destroy the confidence of the fireman in his ability to correctly interpret the signals; and although much good work has been done in London with a system which is an improvement on that which has found so much favour in the United States and in Holland and Germany, yet we venture to think that the new system will prove greatly superior to that referred to. The receiving apparatus (R, fig. 1) is inclosed in a single case, the face being not unlike that of a clock—the alarum which draws attention to the signal being upon the top of, and a key for the acknowledgment of the signal beneath, the dial. The single hand or pointer, with which the dial is furnished, points to the name of the street or post in which the signalling box is placed and from which the alarm is given. This pointer is restored to the zero or starting point by the movement of the key which sends the acknowledgment of the signal; the same movement also arrests the ringing of the call-bell, which would otherwise continue to ring until attended to. The signalling apparatus for the street is placed on or in a pillar, or in a recess in the wall of a building. It is furnished with a door in which is fastened a pane of glass, opposite the signalling handle. This glass is intended to be broken when the proper key is not at hand. The handle of the signalling apparatus is labelled " Pull;" and to give an alarm, it is only necessary to pull it once, when it winds and starts a short clock train of one wheel and a pinion, and transmits the signal. The handle meanwhile is entirely detached from the rest of the mechanism, and nothing that the sender can do will interfere with the due transmission of the signal. The mechanism of the signalling apparatus is shown in fig. 2, and is the same as that usually employed,* but instead of the cam wheel interrupting the circuit in a way to cause groups of dots and spaces to be embossed on a Morse tape, it is only necessary to interrupt the circuit as many times as there are steps from the zero point of the indicator to the name of the box which signals. In the front of the signal box or post, which is shown in front elevation by T, fig. 1, there is an aperture

* For full descriptions of the working of the transmitter, which in general principle, with the exception mentioned, is identical with that now referred to, see TELEGRAPHIC JOURNAL, July 15th, 1880.

in which a disc makes its apearance, owing to the reversal of the line current by the action of the acknowledgment key before mentioned. The front door of each box when closed short-circuits the electro-magnet which actuates the disc, and thus prevents damage to the apparatus from lightning, and also reduces the resistance of the circuit, and consequently the amount of battery power required. Any failure of this part of the apparatus would not, unless it occurred in several signalling boxes at a time, affect the signals, as the range of sensibility of the receiving apparatus is very considerable. To prevent tampering, a trembler bell is sometimes included in the apparatus in the signalling box; it starts ringing upon the breakage of

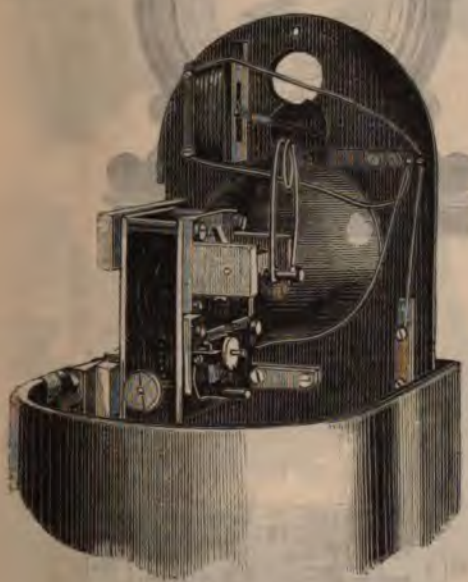


FIG. 2.

glass, or the opening of a door, and is calculated to arrest the attention of passers-by. This safeguard is found to be of considerable service, as the statistics of false alarms derived from Captain Shaw's report show:—from 15 Bright's Fire Alarms, not so provided, there were received 19 false alarms; from 25 Exchange Telegraph Co.'s Fire Alarms, provided with bells, there were received only 14 false alarms. Or, unprotected boxes average 1·26 false alarms per box, and protected boxes average 0·56 false alarms per box.

The general arrangement of the apparatus is shown by fig. 1, Nos. 1, 2, and 3, representing signal boxes or posts, and R, the dial receiver, which is actuated by a local battery, L, called into action by a relay worked by the line battery, B.

MAX SABEL.

Mr. Max Sabel, of 2, Coleman Street Buildings, exhibit rolls of telegraph tape for the Morse, Hughes, and Meyer instruments, also for the Wheatstone automatic puncher, the siphon recorder of Sir W. Thomson, &c. The rolls are made in all sizes, exactly to fit the respective instruments, and the paper is tinted to any shade required. The slip is rolled tight, parallel along its whole length, is cut sharp and clean, and is freed from dust by a patent process. A speciality in the paper is the glazed quality which absorbs the printing ink in the shortest possible time and moreover uncoils freely.

THE SCIENTIFIC TOY AND GENERAL NOVELTY COMPANY.

The apparatus exhibited by this Company is adapted for teaching the principles of science by means of cheap instruments, such as are within the means of most boys. Boxes containing a quantity of apparatus and book of instructions for performing a number of experiments in electricity are shown; these boxes range from 6d. to 5s. each, and are calculated to give a boy a taste for scientific pursuits and induce him to search for further information in books that probably he would never have read had he not been first captivated with the seductive illustrations of wonderful experiments, which are shown on the lids of these boxes, and where flashes of forked lightning are seen issuing from gigantic Leyden jars, to the intense satisfaction of a small boy, occupy a prominent position on the same picture.

A model electric lamp for 1s. is shown; this is an automatic lamp having a thick carbon rod fixed on the base, and a fine carbon resting on the stout one and falling by its own weight as it is consumed. A battery of four Fuller cells will give a bright star of light for one hour.

The "Galvanophone," or "Electric Songster," which is also exhibited, consists of a transmitter which can be connected through any length of wire with the galvanophone, the latter being a small instrument of polished boxwood with a telephone mouth-piece. Any musical notes can be sent from the transmitter, and the same are reproduced by the galvanophone with considerable power.

JULIUS SAX.

The exhibit of Mr. Julius Sax, of 108, Great Russell Street, Bloomsbury, consists chiefly of electric bells for houses, hotels, offices, &c., insulators for telephone stations, which, though excellent of their kind, do not possess any remarkable features of novelty which call for special description. Mr. Sax also shows an electrical water-gauge (patented) for recording the height of water in tanks or reservoirs. This apparatus, which is shown in general view by figs. 1 and 2, and in detail by figs. 3 and 4, consists of two parts:—No. 1. The transmitter, fixed over or near the cistern. No. 2. The receiver, which may be fixed at any distance away from it. The wheel, P, of the transmitter, fig. 3, carries a float (not shown in sketch), which float causes the wheel to turn in any direction. The same wheel is geared in the pinion and axle, A, which pinion is calculated to turn round once at each inch of the rising or falling of the float. The axle, A, carries two insulated weights, which are loose on the former, and are constrained to travel in one direction, by a small trigger arranged for this purpose. By the falling of the float the one weight, W, is carried round and so causes the contact, C, to pass over the springs,

S, sending a copper current through the line to the receiver. By the rising of the float a second weight rises in the opposite direction, causing the contact, Z, to pass over the springs, S^1, sending a zinc current in the line to the receiver. These currents cause the permanent magnet, M, of the receiving instrument (fig. 4) to move

machines are those indicated by figs. 1, 2, and and of lamps those represented by figs. 4 and 5 Fig. 6 shows the Siemens dynamometer, an in strument which is coming into extensive use f the measurement of strong currents such as a used for electric lighting. The principle of t apparatus is that of the attraction and repulsion

FIG. 1

FIG. 2.

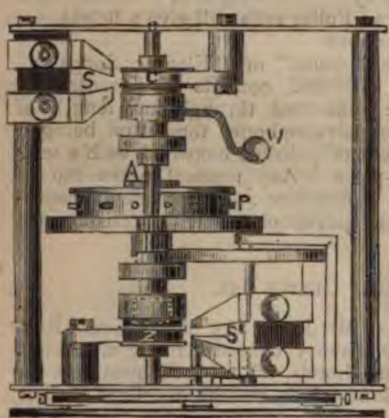


FIG. 3.

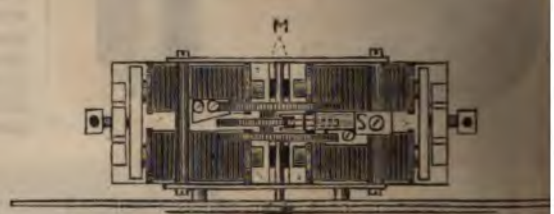


FIG. 4.

either to the right or to the left, and so actuate the wheels carrying the hands. If the hand of the receiving instrument is adjusted to work with the hand of the mechanical dial, the former will always follow the latter and so show the state of the water in cistern, reservoir, or river, at any distance away. The apparatus is also arranged to ring an alarm-bell, both when the water has reached the highest or lowest points.

SIEMENS BROS. & CO., LIMITED.

The electric lighting exhibit of Messrs. Siemens is of an extensive character, and comprises every variety of machine and lamp of the descriptions designed by the firm. The general types of

one wire coil by another; one of these coils suspended by a spiral spring, and the force of th attraction and repulsion is measured by observin the angle of torsion which has to be given to th spring in order to bring the suspended coil bac to its zero position, that is to say at right angle to the fixed coil. A table is provided with eac instrument which shows the strength of curre in webers corresponding to any particular angle torsion.

Messrs. Siemens exhibit being of a very exte sive nature we are compelled to leave its continu tion to a future number.

* For full descriptions of this apparatus see TELEGRAPH JOURNAL, Nov. 15th, 1877, Sept. 1st, Oct. 1st, Dec. 15th, 1879.

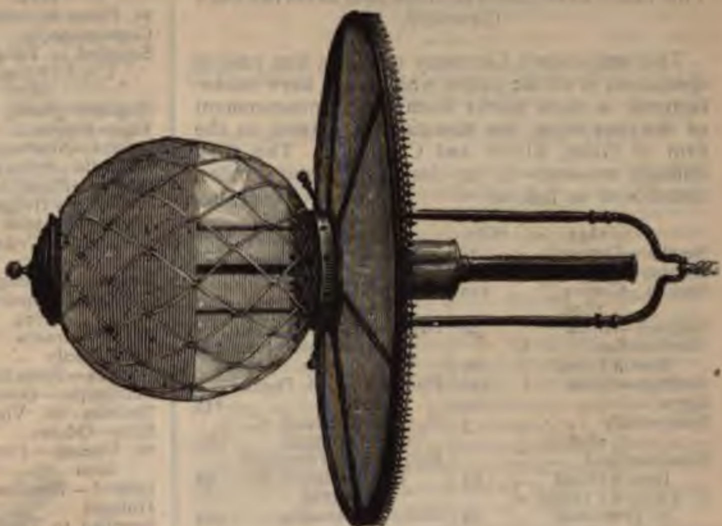


FIG. 4.

FIG. 3.

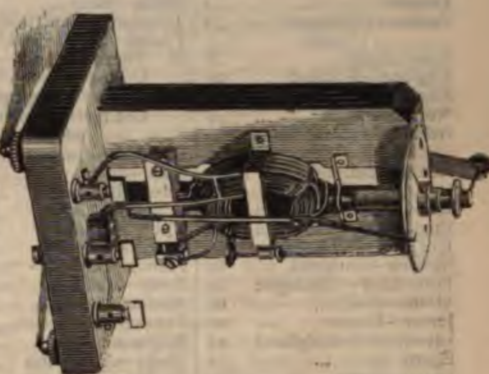


FIG. 6.

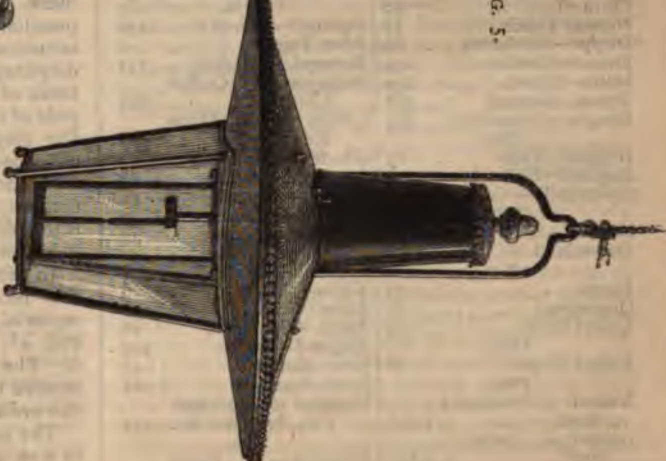


FIG. 5.

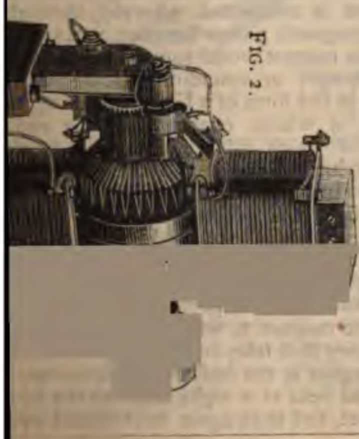


FIG. 2.

THE TELEGRAPH CONSTRUCTION AND MAINTENANCE COMPANY.

This well-known Company exhibit a fine case of specimens of all the cables which they have manufactured in their works from the commencement of the time when the manufactory existed as the firm of Glass, Elliott and Company. The total mileage amounts to no less than 63,628 miles, distributed as follows :—

	Miles.
1854.	
Sweden—Denmark ...	12
Corsica—Sardinia ...	10
Spezzia—Corsica ...	110
1855.	
Sardinia—Africa ...	50
Newfoundland — C. Breton Island ...	74
Sardinia—Africa ...	160
Egypt	10
Italy—Sicily	5
1856.	
Newfoundland — C. Breton Island ...	85
P. Edward's Island — N. Brunswick ...	12
C. Breton Island — Nova Scotia ...	1
1857.	
Norway Fiords ...	49
Danube	3
Ceylon—Hindostan ...	30
1858.	
Italy—Sicily	8
England—Holland ...	129
England—Hanover ...	280
Norway Fiords ...	49
Ireland — Newfoundland ...	1,012
Atlantic Tel. Co. ...	1,163
1859.	
Denmark—Heligoland	46
England — Heligoland	328
I. of Man—Whitehaven	36
Sweden—Gothland ...	64
Folkestone—Boulogne	24
Malta—Sicily	60
Jersey—France	21
Liverpool — Holyhead	19
Egypt	2
Indian Rivers	10
1860.	
France—Algiers ...	520
1861.	
Corfu—Italy	90
Norway Fiords ...	16
Dieppe—Newhaven ...	80
France—Corsica ...	195
Malta—Tripoli ...	230
Tripoli—Bengasi ...	508
Bengasi—Alexandria...	593
1862.	
Ireland—Wales ...	63
England—Holland ...	125
Greencastle — C. Clear	2
1863.	
Sardinia—Sicily ...	211
Queensland	18
1864.	
Egypt	13
Queensland	11
United States	10
1865.	
United States	30
1866.	
Ireland — Newfoundland ...	1,896
Ireland — Newfoundland ...	1,852
England—Hanover ...	224
1866.	
Persian Gulf	170
Sweden	6
Newfoundland — C. Breton Island ...	91
Supplied to Telegraph Cos. for repairs, &c.	260
1867.	
Placentia — St. Pierre Island	112
St. Pierre Island—C. Breton Island ...	183
Supplied to Telegraph Cos. for repairs, &c.	98
1868.	
Malta—Alexandria ...	924
Italy—Sicily	9
Supplied to Telegraph Cos. for repairs, &c.	58
1869.	
Malta—Sicily	54
Tasmania — Australia	176
France—St. Pierre Id.	2,584
St. Pierre Island — United States ...	749
Supplied to Telegraph Cos. for repairs, &c.	299
1870.	
England—France ...	101
Suez—Aden	1,460
Aden—Bombay ...	1,818
England—Lisbon ...	823
Lisbon—Gibraltar ...	331
Gibraltar—Malta ...	1,120
France—Bona... ...	447
Bona—Malta	386
Madras—Penang ...	1,408
Penang—Singapore ...	400
Singapore—Java ...	557
Malta—Alexandria ...	904
St. Maura—Ithaca ...	7
Zante—Trepito ...	11
Supplied to Telegraph Co's. for repairs, &c.	636
1871.	
Portugal—Gibraltar ...	150
River Tagus	1
Portugal—Gibraltar ...	141
Singapore — Cochin China	620
Cochin China—Hong Kong	975
Rhodes—Marmarice ...	22
Latakiyah—Cyprus ...	86
Samos — Scala Nuova	11
Mityleni—Aivali ...	13
Khania—Retimo ...	32
Retimo—Khandia ...	41
Khandia—Rhodes ...	201
Khios—Chesmeh ...	6
Zante—Corfu	150
Zante—Cephalonia ...	18
England—Prussia ...	223
Java—Sumatra ...	55
Java—Australia ...	1,082
Supplied to Telegraph Cos. for repairs, &c.	447
1872.	
Placentia — St. Pierre Island	110
1872.	
St. Pierre Id.—Sydney	182
Constantinople ...	5
Supplied to Telegraph Cos. for repairs, &c.	29
1873.	
England—Spain ...	619
Vigo—Lisbon	247
Ireland—Newfoundl'd	1,876
Placentia—Sydney ...	314
Sydney—Placentia ...	280
Neuwerk— Heligoland	31
Lisbon—Madeira ...	613
Alexandria—Crete ...	359
Crete—Zante	238
Supplied to Telegraph Cos. for repairs, &c.	226
1874.	
Zante—Otranto ...	187
Italy—Sicily	5
Jamaica—Porto Rico...	647
Martinique—Dominica	37
Madeira—St. Vincent	1,196
Kilia—Odessa... ...	349
St. Vincent — Pernambuco ...	1,844
Ireland — Newfoundl'd	1,837
Holland	3
Supplied to Telegraph Cos. for repairs, &c.	776
1875.	
Italy—Sardinia ...	118
Yankalilla— Kingscote	38
Supplied to Telegraph Cos. for repairs, &c,	35
1876.	
Australia—N. Zealand	1,282
Cook's Strait, N. Z. ...	45
Suez—Aden	1,443
1876.	
Supplied to Telegraph Cos. for repairs, &c.	201
1877.	
Aden—Bombay ...	1,[illegible]
Penang—Rangoon ...	853
Marseilles—Bona ...	403
Bona—Malta	3[illegible]
Supplied to Telegraph Cos. for repairs, &c.	747
1878.	
Para—Maranham ...	309
Torpedo Cables ...	289
Alexandria—Cyprus ...	327
Supplied to Telegraph Cos. for repairs, &c.	1,503
1879.	
Penang—Malacca ...	274
Natal—Delagoa ...	344
Delagoa—Mozambique	966
Malacca—Singapore ...	116
Prussia—Norway ...	251
Mozambique—Zanzibar	631
Singapore—Java ...	919
Aden—Zanzibar ...	1,908
Supplied to Telegraph Cos. for repairs, &c.	223
1880.	
Java—Australia ...	1,131
Wanganui — Wakapuake, N. Z. ...	105
Hong Kong—Luzon ...	528
Placentia—St. Pierre...	109
Ireland—Newfoundl'd	1,423
England—Norway ...	423
Norway—Sweden ...	94
St. Pierre—Sydney ...	185
Supplied to Telegraph Cos. for repairs, &c,	985

LOCKWOOD AND BARTLETT'S TELEPHONE RECEIVER.

AN improved form of telephone receiver has been patented in England and America by Messrs. Lockwood and Bartlett, and seems likely to prove a valuable modification of the ordinary Bell instrument. Figs. 1, 2, and 3 show the new invention. The peculiarity of the arrangement consists in the construction of the end of the magnet to which the diaphragm is connected, whereby, through variations of magnetic power between parts of the same pole of the magnet, vocal sounds are transmitted to the diaphragm or sounding board ; this end is extended in the form of a U shaped spring, the outer free end of which, overhanging the end of the magnet, of which it is an extension, is expanded into a diaphragm, or has the latter connected with it in the manner to be explained.

In the figs., A represents the body or handle of the receiver, made of wood or other suitable material, cylindrical in form, and enlarged at one end, A¹, to receive the diaphragm, B, and ear piece, C. The handle, A, is perforated longitudinally to receive the magnet, B, which has a bobbin, E¹, as in the ordinary Bell telephone.

The magnet at the end, D¹, is drawn out, reduced in size, and bent at a right angle to the body, D, of the magnet, and then again bent round upon itself

form until the outer end, a^1, overhangs the ^{1}, of the body of the magnet as shown.
[...]n the end, a^1, is expanded to form the [...]gm, B, as in fig. 3, then the U portion a^1 of the extension lies outside the case, A^1. [...] been found, however, that as good practical have been obtained by making the diaphragm d, parchment, brass, &c., so as to act as a [...]g board; in this case the end, a^1, of the t is not expanded to form a diaphragm as in

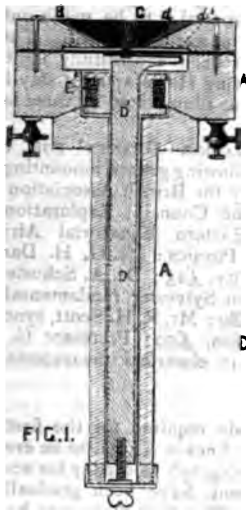


FIG. 1.

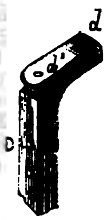
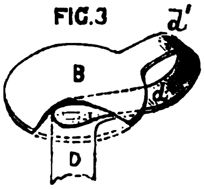


FIG. 2.

[...]ut is formed as shown by fig. 2, and the end [...]xtension is attached to the centre of the [...]gm of wood or other material, as shown r.
[...]mpared with the Bell instrument it will be [...]t the action of the new telephone is reversed, he Bell arrangement the diaphragm is in a tension due to the attraction of the latter permanent magnet; in the Lockwood [...]ent the diaphragm is repelled by the action

FIG. 3



[...]ermanent magnet, since the polarity of the he latter and its extended end are the same. [...]ative actions of the currents in both forms [...]uments must, however, it is obvious, be though the relative movements of the [...]gms in the two cases are reversed.
[...]ave had an opportunity of hearing the [...] capacity of this instrument, and can testify [...]fficiency, the articulation being remarkably [...]o much so indeed that recitations from [...]eare, and also sentences which are most to render telephonically were heard with distinctness.

Correspondence.

CITY AND GUILDS OF LONDON INSTITUTE EXAMINATIONS.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—With reference to this subject, which was alluded to by your correspondent, "A Student," in your issue of the 15th inst., and on which you had an article in your last number; as one who has had some experience in the subject of telegraphy, permit me to draw attention to the discouraging nature of the result of the recent examination. The small number of those who succeeded at the examination, and, particularly, the small percentage of first-class certificates awarded, shows that the standard required, even in the elementary stage, was exceedingly high. I do not know what in the opinion of the examiner may constitute an "elementary" knowledge of telegraphy; but seeing that the supposed object of the institute is to encourage, technical education, I would respectfully suggest to him that there may be a better way of doing this than by requiring elementary students to give evidence of a decidedly advanced knowledge of the subject. Neither students nor teachers can be said to be "encouraged" when they find that success, even in the elementary stage, is extremely problematical. The institute is stated to conduct its work of examination on the same lines as the Science and Art Department; but it is well known that this department affords a real and tangible encouragement to the study of science, and that in the lower stages it makes a fair allowance for the imperfect knowledge of learners—this it does both by permitting a choice of questions, and by being satisfied with something short of actual perfection in those attempted. If the work of South Kensington had been conducted in the spirit of the institute, it would never have attained to its present condition of usefulness. The examiner, in his report, remarks upon the absence of drawings to illustrate answers; and I can understand that students would not always give drawings, as no reference was made to them in the examination paper; but I am in a position to assert, that even a profusion of drawings, together with a very respectable knowledge of the subject, have been, in many cases, insufficient to obtain more than a "pass," and sometimes not even that.

Allow me to point out that the plan of giving ten questions, all of which are, apparently, expected to be answered, is a very faulty one. It makes no allowance, and even if a student is able to answer them all, he cannot do so in the time allowed; either he must omit some, or he must hurry through them in such a way that he cannot do justice to himself. Why cannot the South Kensington plan be adopted, of giving ten or twelve questions, and requiring only eight of them to be attempted? The recent alteration in the regulations, by which the elementary and advanced stages are to be combined, seems to me to be a step in the wrong direction. It has hitherto been too difficult to obtain the certificates in these two stages, and now that they are combined, it may fairly be supposed that it will be even more so—at least, so far as the elementary students are concerned. The institute should bear in mind that in order that qualified men may be encouraged to form and teach classes, it is absolutely necessary that they may be able to depend upon gaining something more than the meagre grants hitherto obtained; and if students are to enter these classes, they must have some assurance that their studies will enable them to pass the examinations creditably.

In conclusion, I would state that this subject of technical education is, in my opinion, of far too important a character to be left to the voluntary efforts of a private and irresponsible body, however well-meaning, and that the time has arrived when it can only be efficiently dealt with by Government.

Yours truly,
W. M. M.

Notes.

THE SWAN LIGHT IN THE BEAUFORT THEATRE.—Mr. D'Oyley Carte's new theatre is to be lit by 600 Swan lamps. The dynamo machine for the purpose will be supplied by Messrs. Siemens Bros., by whom the contract has been undertaken.

THE ELECTRIC LIGHT ON SHIPS.—The s.s. *City of Berlin* and the s.s. *Potosi* have been fitted with Messrs. Siemens Brothers' differential lamps. The s.s. *City of Paris*, the *City of Rome*, the Cunard s.s. *Servia*, and the Guion s.s. *Alaska*, are all fitted partly with Swan lamps and partly with the differential lamps. Also the s.s. *Trojan* of the Union Company has one continuous current lamp. The dynamo machines in all these instances have been made by Messrs. Siemens Bros., and are of their well-known types.

INFRINGEMENT OF ELECTRIC LIGHT PATENTS IN AMERICA.—The principal electric lighting companies in America, comprising the Brush, the United States, the Fuller, the American, the Jablochkoff, and the Western, have united in an organisation to enforce their numerous and important patents against manufacturers and users infringing patents.

THE ELECTRIC LIGHT IN GLASGOW.—The electric light is to be introduced into the Girbal Tube Works, Glasgow. The form of lamp to be used is stated to be a patent of Messrs. D. and G. Graham of that city.

THE ELECTRIC LIGHT IN COCKERMOUTH.—It has been decided to light the large places of Cockermouth by the electric light, and the small streets by Orion gas oil lamps.

THE ELECTRIC LIGHT IN DUNDEE.—The electric light has been successfully introduced into the establishment of Messrs. Lamb, Dundee. The Dundee Gas Commissioners have decided that the introduction of the electric light into Dundee shall not be left to any private company or speculative promoters, but to themselves. In the meantime the gas manager is to devise means for making experiments with the electric light at the gas works.

THE AMERICAN TELEGRAPH AND CABLE COMPANY.—This Company has announced that it commences business to-day. The second cable of the Company will be completed, it is expected, shortly. Until this second cable is ready for traffic, the rate to New York will be 1s. 6d. per word. In London the Company's address is. 21, Royal Exchange.

TELEGRAPHIC COMMUNICATION WITH THE ORKNEYS.—The inhabitants of South Ronaldshay (Orkney) have received, in answer to their application to the Post Office for telegraphic communication, a reply that an annual guarantee of £545 will be required.

LIGHTING TRAINS.—The Great Northern Railway Company have commissioned Messrs. Crompton to fit up a train with Swan's incandescent electric lamps.

THE ELECTRIC LIGHT IN EDINBURGH.—The trial of the Brush system of electric lighting for the streets of Edinburgh, which began on the 25th ult., has not been very satisfactory. The first night, after burning only for a short time, it went out, owing, it is said, to the want of water for the engines; and the succeeding night it burned brightly from eight o'clock to about half-past ten, again disappearing owing to the failure of the engine. No further trial is to be made until another engine of sufficient power is obtained. The Waverly railway station has been successfully lighted by the electric light. During Her Majesty's stay in the city, Holyrood Square was illuminated by three lamps.

BRITISH ASSOCIATION GRANTS FOR SCIENTIFIC PURPOSES.—The following grants, amounting to £1,280, have been made by the British Association for scientific purposes:—The Council: Exploration of mountain district of Eastern Equatorial Africa, £100. Mathematics and Physics: Mr. G. H. Darwin, lunar disturbance of gravity, £15; Dr. A. Schuster, meteoric dust, £20; Professor Sylvester, fundamental invariants (partly renewed), £80; Mr. R. H. Scott, synoptic charts of the Indian Ocean, £50; Professor G. C. Foster, standards for use in electrical measurements (partly renewed), £100.

ALL the materials required for the first section of the telegraph land lines in China, to be erected by the Great Northern Telegraph Company for account of the Chinese Government, have been gradually sent for some time since. The first shipments have arrived, and the line is now being very expeditiously erected. Meanwhile the Chinese authorities have thought it desirable that the line should be duplicated from the very beginning, and the Great Northern Telegraph Company are therefore now preparing to ship all the materials required for that purpose.—*Journal of the Telegraph.*

PRACTICAL INSTRUCTIONS ON THE USE OF THE DIAGOMETER IN TESTING OILS AND TISSUES. IMPROVEMENTS IN THE DIAGOMETER.—By L. Palmieri.—The author applies his "bifilar electrometer" to the examination of oils and tissues, in order to ascertain whether olive oil is pure or mixed with other oils, and whether cotton is present in silk and wool. At the upper extremity of a dry column, erected freely in a glass cylinder, and whose top, for the sake of better insulation, does not touch the glass cylinder, he introduces a lever which can be made to turn on a horizontal axle, which supports at one of its ends a vertical metal wire, terminating in a finer wire. Such another lever is connected with the charging-wire of an electrometer. If the oil to be examined is placed in a glass trough and the two metal wires are plunged into it, always in the same manner, the time which elapses until the electrometer shows a certain deviation, say, 5° or 10°, gives a measure for the conductivity of the oil. For the purest olive oil, which was first examined, this is very small, but in samples mixed with other oils it is decidedly greater. Hazel-nut oil and pine oil form an exception, but they are not likely to be used for the adulteration of olive oil. If in place of the oil there is used the thread of any tissue it can be perceived whether it consists of non-conductive silk or of conductive cotton, or of a mixture. The instrument was constructed by the author chiefly for investigating atmospheric electricity.—*Wiedemann's Beiblatter.*

ON THE VARIABILITY OF THE RESISTANCE OF SELENIUM.—By J. Dicks.—Selenium spread upon a glass plate between two spiral copper wires had, at 5°, 10°, 20°, and 30°, the respective resistances of 1, 0.86, 0.59, and 0.40 X 66,000 ohms. If melted it conducts well. If illuminated at different distances or with several candles the results were correspondent. —*Wiedemann's Beiblatter.*

THE CONSTANT AND DEPOLARISED VOLTAIC COLUMN. — By G. Mocenigo. — Circular alternately connected copper and zinc plates are fixed upon a horizontal axis, kept in rotation by an electro-magnetic machine, and dip with their lower third part into the several compartments of a trough which can be raised or lowered. The metallic ends of the axle serve to connect the column with the remainder of the circuit. The trough is supplied with the exciting liquid through tubes leading to a reservoir.—*Wiedemann's Beiblatter.*

CONSTANT AND POWERFUL BATTERY, WHOSE RESIDUES CAN BE ELECTRICALLY REGENERATED.—M. Reynier.—The amalgamated zinc plate, from which is cut out a strip projecting up out of the liquid, dips in caustic soda, and the copper element in the solution of blue vitriol. Both are separated by several leaves of parchment paper folded together. The original electro-motive force of the element is 1.47 volts, but after prolonged action it sinks to 1.35. The resistance of an element 0.2 metre in height and containing 3 litres = 0.075 ohms. If the direction of the current is inverted the previous conditions are restored. The liquids can be made more conductive by the addition of salts.—*Wiedemann's Bieblatter.*

THE ELECTRIC LIGHT IN LIGHTHOUSES.—A new lighthouse, in which the electric light is to be used, has just been completed at Marseilles. The cost of the light will be about 2s. 3d. per hour, against 3s. 1d., the cost of the ordinary light; but taking into account the intensity of the flame, the cost of the electric light is seven times less than the cost of that which it will replace. The new lighthouse will be one of the finest on the French coasts. The light, which will be equal to 3,500 gas jets, will be visible at a distance of 27 miles.

New Patents—1881.

3731. "Apparatus for transmitting and receiving audible signals by means of electricity." A. F. ST. GEORGE. Dated August 26.

3768. "Automatic electric signalling apparatus (armatures, &c.)." W. MORGAN BROWN. (Communicated by O. Gassett & J. Fisher.) Dated August 30. (Complete.)

3771. "An improvement or improvements in the production of voltaic electricity." A. BANKS. Dated August 30.

3790. "Covering, protection, and insulation of electrical conductors, or cables for telegraphic, telephonic, and other purposes." W. R. LAKE. (Communicated by S. D. Strohm.) Dated August 31.

3790. "Covering protection and insulation of electrical conductors or cables for telegraphic, telephonic, and other purposes." W. R. LAKE. (Communicated by S. D. Sthrom) Dated August 31.

3799. "Construction and manufacture of electric lamps." W. CROOKES. Dated August 31.

3804. "Commutators for dynamo or magneto-electric machines, and electric motors; also applicable to other electrical moving contact surfaces." P. JENSEN. (Communicated by T. A. Edison.) Dated September 1.

3808. "Means and apparatus for conveying sound to a distance from theatres, and such like localities, by telephonic transmission." C. D. ABEL. (Communicated by C. Ader.) Dated September 1.

3809. "Apparatus for and arrangements of telephonic exchanges." C. D. ABEL. (Communicated by La Société Générale des Téléphones). Dated September 1.

3812. "Method of and apparatus for transmitting secret messages by electro-magnetic telegraph." W. R. LAKE. (Communicated by A. F. & F. B. Johnson). Dated September 2.

3821. "Electric lamps or regulators." A. L. FYFE and J. MAIN. Dated September 2.

3822. "An improved electric lamp or regulator." A. TUBINI. Dated September 2.

3832. "Machinery for winding or coiling wire upon annular armatures for electro-magnetic or magneto-electric-apparatus or machines." W. R. LAKE. (Communicated by G. R. Haase and J. P. Recker.) Dated September 2.

3857. "A perpetual electro-magnetic motor." C. LE SIEUR. Dated September 5.

3871. "Dynamo-electric machines." H. A. HARBOROW. Dated September 6.

3880. "Improvements in the manufacture of revolving armatures and other parts of electrical apparatus, and in machinery therefor." W. R. LAKE. (Communicated by C. Dion). Dated September 7.

3890. "Electric lamps." D. G. FITZGERALD. Dated September 8.

3893. "Electric lighting apparatus." W. R. LAKE. (Communicated by W. S. Hill). Dated September 8.

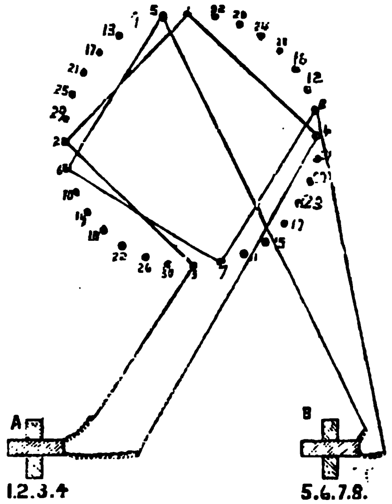
3898. "Improvements in apparatus for igniting gas, for illuminating by means of electricity, and in batteries connected therewith. A. J. HALLAM and J. WALSH. Dated September 8.

3909. "Improvements in and relating to apparatus for indicating the speed and direction of motion of machinery, a part of which invention is applicable also to pneumatic bells." J. L. PATTULLO. Dated September 9.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1881.

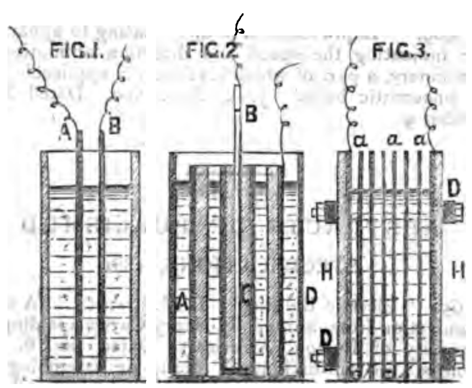
65. "Electric lighting." P. M. JUSTICE. (A communication from abroad by Henry Curtis Spalding, of the City of Boston, America.) Dated Jan. 6. 6d. Consists in sub-dividing a group or assemblage of massed lights into lesser groups, each sub-group being in an electric circuit separate and distinct from the other, and the lights composing each sub-group being so selected as to be interspersed with and separated from one another by the lights of other sub-groups. The figure represents an assemblage of, say, thirty-two lights arranged in a circle; another arrangement contemplates the use of eight batteries or machines, one to each sub-group of four lights. In selecting the lights for each sub-group they are taken from such points in the circle that they will be as far as possible removed

from proximity to one another. For instance, as indicated in the diagram, the circuit controlled by battery A contains four lights, 1, 2, 3, 4, battery B,



5, 6, 7, 8, and so on. Each light of each sub-group is thus separated from its nearest fellow by seven other lights of other sub-groups.

129. "Galvanic polarisation batteries or magazines of electricity." J. H. Johnson. (A communication from abroad by Camille Faure, of Paris.) Dated Jan. 11. 6d. Relates to the well-known Faure batteries, and has reference to the preparation of the elements of these batteries by covering them by mechanically coating, electro-plating, or chemical precipitation or deposit, with a layer of spongy or porous lead of suitable thickness, whereby it is rendered possible to impart to such batteries a considerable power of absorbing and storing

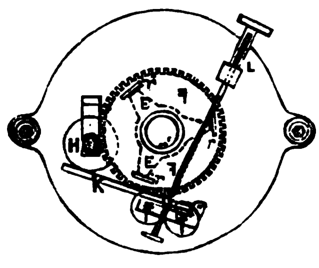


up electrical energy, which may be subsequently employed as required, and the invention also has reference to novel processes and apparatus for enabling this important practical result to be obtained. In carrying out the invention, leaden plates or blades are principally employed as a support for the porous or spongy materials with which they are covered by mechanical application, electro-plating, or galvano-plastic process, chemical precipitation or deposit or by simple adhesion. In order to render these supporting plates capable of storing up a sufficient quantity of electricity, the plate or pair of plates or elements are prepared by covering them with a coating composed of metallic salts or oxides, intimately mixed with inert substances, for example, by employing a coating of sulphate of lead mixed with pulverised coke, which mixture may be moistened with a small quantity of gelatine. The prepared plates are immersed in sulphuric acid and submitted to the action of a battery. The deposit of porous lead on the surface of the element may also be obtained by depositing the lead from a soluble salt of lead by means of galvanism and in a pulverulent condition by employing a powerful current of electricity. The two primary elements may be of a metal other than lead, such as copper for example, and may even consist of coke or carbon and be surrounded with oxides or salts of lead more or less mixed with carbon or other inert substance. The deposit may also be of any thickness, the object in view being to deposit upon the element or upon the two elements a thick layer of metal in a rough and spongy condition and capable of being oxidised to a considerable depth so as to obtain in the batteries by means of one or two operations of short duration the same effect which has heretofore been obtained in batteries of this description, or polarisation batteries, with lead plates, constructed according to what is known as Planté's system in a less efficient manner, and by means of an operation requiring several weeks to carry out. Fig. 1 represents a vertical section of a battery constructed according to this invention, with flat plates as hereinafter described. Fg. 2 is a vertical section of a battery constructed with circular plates or elements. Fig. 3 is a vertical section of a battery composed of flat plates forming cells. According to the arrangement illustrated in fig. 1, a pair of elements having flat and parallel surfaces is employed, being composed of two thin lead plates A and B covered or coated with a porous covering as hereinbefore described, and placed in a rectangular vessel containing water acidulated with sulphuric acid. In the arrangement illustrated in fig. 2, a pair of circular elements is employed, consisting of an external cylindrical element A of lead covered or coated internally with a porous covering as hereinbefore described, and surrounding a central rod B of lead or carbon inclosed in a cylinder or vessel C of porous materials, the whole being immersed in an acidulated liquid contained in a suitable external vessel D. The annular space between the porous cylinder C and the central element is filled in the first instance with sulphate of lead and coke intimately mixed, a certain quantity of coke in a granular condition being also introduced into the mixture with saw dust or other suitable analogous substance in order to obtain a mass sufficiently porous. The space between the porous cylinder C and the external circular element, A, may be filled up all round, or the composition may be supported against the internal surface of the element, A, only by any suitable device, such as a second porous cylinder or vessel arranged externally and concentric to the first, and leaving a clear annular space for the liquid. These two quantities of composition thus applied to their respective elements are then reduced and oxidised as hereinbefore described, or the pasty mass of which they are composed may be previously prepared and introduced round the elements, as it will be readily understood that the paste may be prepared in large elements, and subsequently transferred to other pairs or couples. According to another arrangement, shown in fig. 3, a battery having a number of pairs of plates connected together for currents of high tension is employed, provided with a number of plates, *a*, *a*, *a*, *a*, of lead, which

h present a surface of about one yard in are[a]. ates, *a*, are prepared as hereinbefore described sides and are arranged parallel with each other, red in position at the proper distance apart by f strips or distance pieces, *c*, of india rubber l near the edges of the plates, and are pressed by means of external slabs or plates, H, supy bars, D, of wood, connected by bolts so as to ompact and strong casing, in which each of the etween the lead plates, *a*, forms a cell capable ing the acidulated water without leakage. The etween the plates, *a*, may, if preferred, be filled , asbestos, or other sufficiently porous substance of maintaining the plates at the proper distance id preventing the liquid from splashing in case ttery being moved.

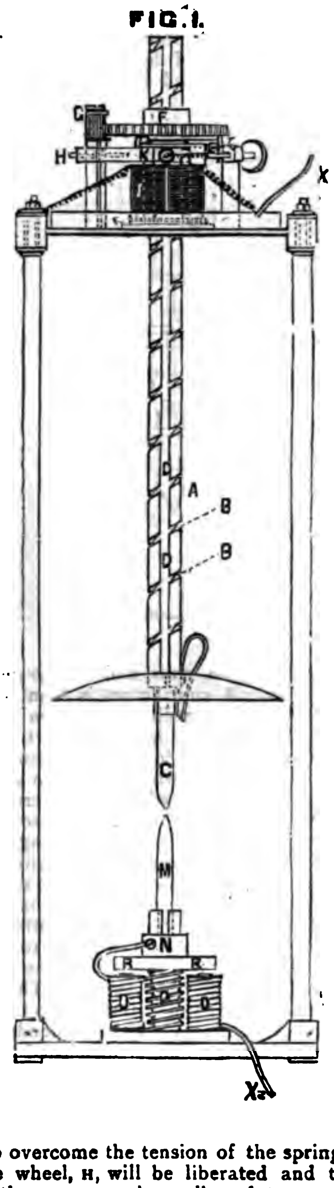
" Electric lamps." A. MUIRHEAD and J. HOP- Dated Jan. 12. 6d. Has for its object chiefly ments in arc electric lamps, and relates both echanism of the lamps and to carbon filaments idescence lamps. Fig. 1 is a view of an elecp constructed according to this invention; a detached view of the brake wheel, with rolling electro-magnet. Referring to fig. 1, rod carrying the upper carbon, C, and having a screw, B, B, and groove, D, D, the screw, B, B, in the fixed nut, E, E (better shown in plan , and the socket of the revolving wheel, F. ket contains a key *o*, fig. 2, working in the D, D. The wheel, F, is geared into a lantern , on the same axis as the break wheel, H, and ution of the latter, caused by the descent of the rough the fixed nut, E, and the socket of the is controlled by the armature, K, of the electro-

FIG. 2.



I, I. The coils of this electro-magnet are con- the terminals and to the insulated rod leading ower carbon, and thus a shunt to the arc is The armature, K, of the electro-magnet, I, I, earing against the brake wheel, H, by means of table spring, L, the tension of which is over- the current in the coils of the electro-magnet, the wheel permitted to revolve whenever the long. The lower carbon, M, of the lamp is y a holder, N, attached to the armature, R, R, ier electro-magnet, O, O, and is kept pressing the upper carbon, C, by the spring, P. The f the lamp is as follows:—Supposing the carbe in contact, on passing a current through the rcuit from X^1 to X^2 the electro-magnet, O, O, excited and draw down the armature, R, R, to- vith the lower carbon, M, the upper carbon, C, revented from following by the brake, and thus will be formed between C and M. As the carrn away the resistance of the arc to the passage of the current becomes greater, and consequently the current in the coils, I, I, of the electro-magnetic shunt becomes greater until the magnet so excited is strong

FIG. 1.

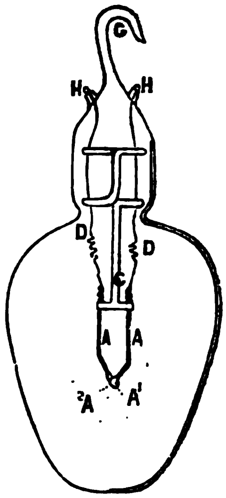


enough to overcome the tension of the spring, L, when the brake wheel, H, will be liberated and the rod, A, carrying the upper carbon allowed to approach the lower one to the required distance.

The carbon filaments are prepared by igniting them in a vessel containing the vapour of bisulphide of carbon.

218. " Apparatus for producing electric light." J. E. H. GORDON. Dated Jan. 17. 6d. Relates to improvements in the inventor's electric lamps for producing light by the discharge of high tension alternating currents between metallic or other balls. The figure is a side elevation of a lamp formed in a way suitable for lamps of great illuminating power. The globe is first formed with a long neck, as shown, and with a con-

traction at the lower end of the neck. Into the neck is inserted a glass rod, C, carrying wire stems, A, and refractory balls, A^1, and having the conducting wires, D, attached to the ends of the stems. The rod, C, is formed with a glass stem terminating in coils which fit within the neck. The lowest coil rests on the contraction at the bottom of the neck, and the balls are thus suspended at any required height within the globe. The conducting wires are led through eyes formed on



the interior of the glass coils, and are so kept apart from one another. A contraction is then formed in the neck; the neck is cut at the contraction and a quill glass tube, G, joined on to it. Two short lengths of quill glass tube, H, are also joined to opposite sides of the neck. The conducting wires are drawn up through the small tubes, H, by means of a hook lowered through them, and the extremities of the tubes are softened and sealed. The extremities of the conducting wires, D, should be bent into small loops so that they may the more readily be caught and drawn up; the ends of the wires should also be just tipped with a small bead of glass before they are put into the neck, otherwise the ends whilst they are being drawn up towards the tubes, H, might scratch the interior of the neck, and render it liable to crack when heated. The tube, G, which is joined on to the end of the neck is bent into a hook form, so that the lamp may be suspended by this hook. Afterwards the globe is exhausted and filled with hydrogen or nitrogen or other inert gas, and then again partially exhausted, and the glass neck then sealed and its end broken off.

225. "Electric lamps," &c. ST. GEORGE LANE FOX. Dated Jan. 18. 6d. Consists of improvements in electric lamps, of the manufacture of improved burners or "luminous bridges" for such lamps, and of means of turning on and off electric currents for lighting and extinguishing lamps. Fig. 1 is a vertical section of one of the improved lamps. A is the flask or globe; *a*, the luminous bridge; *b*, *b*, the platinum wires; *c*, *c*, the spirals formed at the lower ends of these wires, into which the ends of the bridge, *a*, are inserted, and in which they fit tightly, the spirals and bridge being cemented together with Indian or Chinese ink, as already stated. The upper parts of the platinum wires, *b*, *b*, are fused into solid pieces of English lead glass, *d*, *d*, which forms the bottom of tubes, *e*, *e*; the upper ends of the wires extend into thes which contain mercury, and the conducting wi terminals, *f*, *f*, dip into the mercury. The tube are closed at their upper ends by a layer of glue, *g*, and a layer of plaster of Paris or other cem

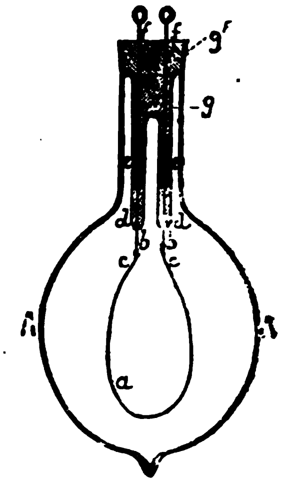


FIG. 1.

For turning on and off the currents for lightin extinguishing lamps, as, for instance, a numb street lamps without lighting or extinguishing the l in adjoining houses, which derive their current fro same electric main as the street lamps, the follo

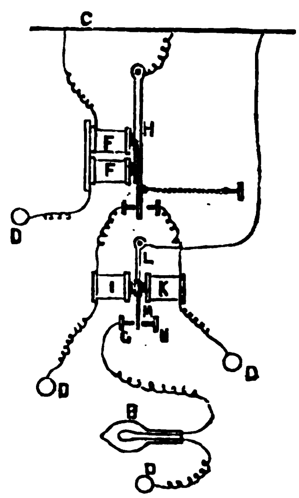


FIG. 2.

means are adopted (Fig. 2):—There is employe connection with every lamp, B, to be lighted o tinguished an electro-magnet, F, of very high resist many times greater than that of the lamp. circuit of this electro-magnet is always closed, so a feeble current is always passing through it fro main, C, to the earth, D. In connection with

is a spring armature, H, the tension of the [...]xactly balancing the attraction of the magnet [...]normal electro-motive force of the main. An [...] or decrease in such force will therefore make [...]ature approach or recede from the magnet. [...]ature is placed so that the movement caused [...]mentary increase of the electro-motive force [...]e circuit of a second electro-magnet, I, and [...] movement caused by a momentary decrease of [...] closes the circuit of a third electro-magnet, K, [...]o magnets being each then joined between the [...]d the earth. One of these magnets, I, turns [...] current on and the other, K, turns it off when [...]cuits are respectively closed. This is effected [...]s of the bar, L, connected with the main, C, [...]ing mounted on it an armature. M. The [...]nt of the bar to the magnet, I, makes contact [...] lamp, B, through the peg, G, while the move- [...] the bar to the magnet, K, breaks the contact. [...]mentary increase of the electro-motive force [...]onveniently produced by the momentary intro- [...]between the main and the earth of a powerful [...]y battery, and the momentary decrease by the [...]hort circuiting of the mains with the earth or [...]dden check of the source of supply of the [...]notive force. N is an insulated stop to pre- [...] armature, M, coming into contact with the [...] K, and therefore avoid the expenditure of [...]otive force which would otherwise take place [...] this magnet when the lamp is not lighted. [...], G, is also so placed as to prevent the armature, [...]g into contact with the magnet, I.

[...] "Apparatus for producing electric currents," [...]ARLES GODFREY GUMPEL. Dated Jan. 20. [...]elates to apparatus for producing electric [...] and for applying such currents for the pro- [...] of light and for the transmission of motive [...]g. I shows one arrangement of the invention, [...] six poles are connected to one extension, *a*, [...] one magnetic field; fig. I shows also the

[...]IG. 1.

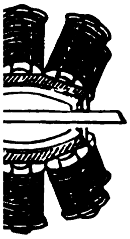
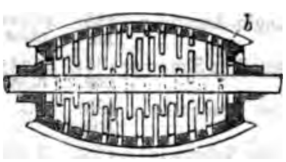


FIG. 2



[...]IG. 3.

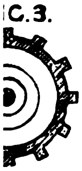
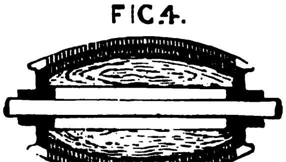


FIG. 4.



[...] made in barrel form according to the inven- [...]tions thereof showing various modes of con- [...] it, being represented to an enlarged scale by [...], and 4. In fig. 2 the soft iron barrel, *b*, of the [...] is slotted to prevent or impede longitudinal [...], the barrel being supported at each end on [...]netic bosses fixed to the central shaft; fig. 4 [...]e barrel constructed of a number of iron rings [...]lly insulated from each other, supported on a wooden core and clamped together by two end bosses. In all cases the surface of the barrel is divided by longitudinal ribs as shown by the transverse section, fig. 3, the spaces between those ribs receiving the insulated copper wire coils. These ribs in the constructions shown in figs. 2 and 4 are in one piece with the barrel or its sections; at each end of each rib there is a projection to facilitate the winding of the coils. One form of electric lamp, according to the invention, is shown in fig. 5. The upper carbon, A, is held in a socket tube having on its side a toothed rack gearing with a pinion, B, which has fixed on its axis a ratchet wheel, C. This wheel rests on a shoe, D, which is hinged to the arm, E, of the armature of an electro-magnet, F, this arm being sustained by an adjustable spring, G. A spring pawl rack, H, bears against the ratchet wheel, C, which along with the pinion, B, is mounted in a movable frame, K, having its descent limited by an adjustable stop nut, L. The coil of F being in the lamp circuit the action is as follows:—

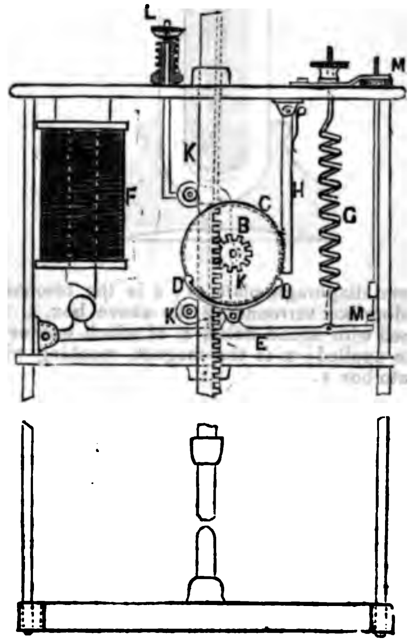
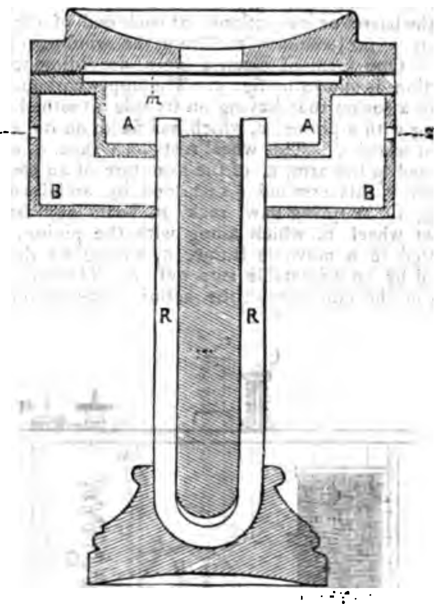


FIG. 5.

The carbons being in contact when a current is transmitted, the electro-magnet, F, becoming excited attracts its armature, thus lifting the shoe, D, and with it the wheels, B and C, and frame, K, and thus raising the upper carbon to the extent determined by an adjustable stop, M, and starting the arc. Should the distance between the carbons become too great, the electro-magnet loses attractive power, allowing the carbon to descend, during which descent the wheel, C, being held by the pawl rack, H, is caused to turn partly round, feeding forward the carbon, whereupon the electro-magnet again acts, adjusting the distance of the carbons.

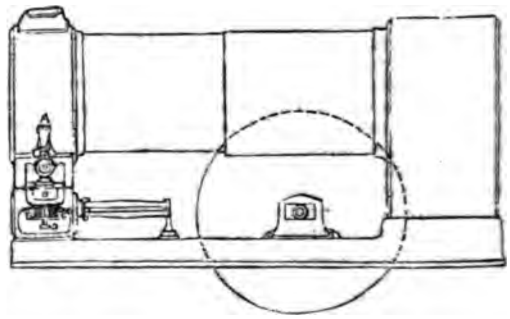
286. "Telephones." FRIEDRICH H. F. ENGEL. (A communication from Johann Heinrick Königslieb, of Hamburg.) Dated Jan. 22. 4d. Relates to certain improvements in telephones, and has for its purpose to increase the power of transmitting sounds, words, and

so forth, by such instruments, and also to render more distinct or clear the transmitted words or sounds. In the figure A is a thin walled wooden box forming part of the casing or body of the instrument placed underneath



the metal diaphragm plate, *m*; B is the resonance or resounding-box surrounding the above box, A, and is furnished with sound holes, *s*, of which one or more may be applied; R is the magnet, reaching with its ends into box A.

288. "Controlling engines for driving dynamo-electric machines." J. RICHARDSON. Dated Jan. 22. 8d. Relates to an improved method of and appliances for controlling and regulating the speed of engines employed for driving dynamo-electric machines. The engine steam passage is fitted with an equilibrium throttle valve, which is acted upon by a sensitive high speed governor, upon which is mounted a small dynamo-electric machine, which is actuated by the same current as that which produces the light, so that its power shall vary in the same proportion as the intensity of the current varies. The figure shows a side elevation of a Robey engine. A is a high speed governor acting direct upon an equilibrium valve contained within the chest, B. Instead of driving this governor in the ordinary manner by a belt, strap, or gearing from the engine, it is driven by a small electro-motor, C, which may be attached direct to it, or it may be fixed at a distance. This electro-motor is actuated by a portion of the main current which produces the electric light, and its speed varies in relation to the intensity of the said current, so that when the large dynamo-machine which produces the current has reached such a speed as gives the required intensity, the governors at the same time attain sufficient speed to shut off all further admission of steam, and the current is therefore retained exactly at this intensity; and as all changes of intensity, however minute, instantaneously affect the admission of steam, whatever may be the variations of intensity in the current, these are instantaneously rectified by a greater or less admission of steam, thus maintaining the current at a practically uniform intensity. It is evident *that while the governing* would be perfect so long as the large dynamo-machine were being driven, yet should any accident arise to the driving belt of this machine or other connections between it and the steam engine so as to cause its stoppage, and therefore a cessation of current, the governors would instantly fall, and full steam would be admitted to the engine. This is automatically prevented in the following manner:— The stalk of the equilibrium valve is prolonged through the bottom of the valve chest, as shown at D. Upon



this is slung an electro-magnet, E, whose weight is sufficient to close the valve. So long as any current is passing a small portion of this is taken through the said electro-magnet, and it is magnetically held to the underside of the valve box, B, thus leaving the equilibrium throttle valve to be freely acted upon by the governor. The moment the current ceases, however, this loses its magnetic force, and falls upon the collar of the stalk, D, thus holding it down and preventing any further admission of steam.

TRAFFIC RECEIPTS.

NAME OF COMPANY.	JULY.	AUGUST.	REMARKS.
	£	£	
Anglo-American...1881	46,410	..	After July the publication of the receipts of this company will be suspended.
1880	*19,500*	..	
Brazilian S'marine 1881	11,755	11,980	
1880	*10,[illegible]*	*10,317*	
Cie. Française ...1881	...	...	
1880	..	..	Not published
Cuba Submarine...1881	2,300	2,300	
1880	*2,915*	*1,[illegible]*	
Direct Spanish ...1881	1,448	1,507	
1880	*1,423*	*1,197*	
Direct U. States...1881	15,470	...	After July the publication of the receipts of this company will be suspended.
1860	*6,500*	..	
Eastern 1881	38,171	42,797	
1886	*43,358*	*40,968*	
Eastern Extension 1881	31,751	30,349	
1880	*32,194*	*30,169*	
Great Northern ...1881	22,400	21,200	
1880	*25,560*	*22,800*	
Indo-European ...1881	...	...	
1880	..	..	Not published.
Submarine 1881	...	...	Publication temporarily suspended.
1880	..	..	
W. Coast America 1881	...	...	
1880	..	..	
West. & Brazilian 1881	9,396	7,745	
1880	*8,611*	*7,001*	
West India 1881	4,116	3,427	
1880	*2,718*	*2,891*	

THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. IX.—No. 208.

THE PARIS ELECTRICAL EXHIBITION.

THE BRITISH SECTION.

SIEMENS BROS. & CO., LIMITED.
(*Continued.*)

"MAGNETO EXPLODERS" of various sizes, similar to that described in the number of the Journal for

FIG. 8.

FIG. 9.

FIG. 10.

FIG. 11.

August, 1880, are amongst Messrs. Siemens' exhibits. The largest size will fire $\frac{1}{4}$ inch of iridio-platinum wire ·0015 in. in diameter, through 70 ohms resistance; the next size will fire the same wire through 50 units. The "large dynamo tension exploders" shown will give a spark $\frac{1}{25}$th inch long; the smallest size will give a spark $\frac{1}{300}$th inch long.

FIG. 7.

Conspicuous amongst the "materials for the construction of land lines," are Messrs. Siemens' well-known "IRON TUBULAR TELEGRAPH POLES." These

poles are constructed with a view to obtain the greatest possible strength and durability, with the least possible weight, and to give each of the pieces composing the pole a convenient form for easy transport. Formerly these poles were made with buckled plates at their base (specimens of these are shown) so as to give stability to the same, but in order to reduce the labour of erection, without, however,

FIG. 12.

diminishing the quality and strength of the material, the wrought-iron plates have been replaced by Le Grand and Sutcliffe's cast-iron tubular base-pile. The complete pole is represented by fig. 7; the base-pile, *a*, which is shown in section by fig. 8, is driven into the ground by means of a hand rammer, *r*; this rammer is raisedtwo or three feet and then allowed to drop upon the flat head of the solid

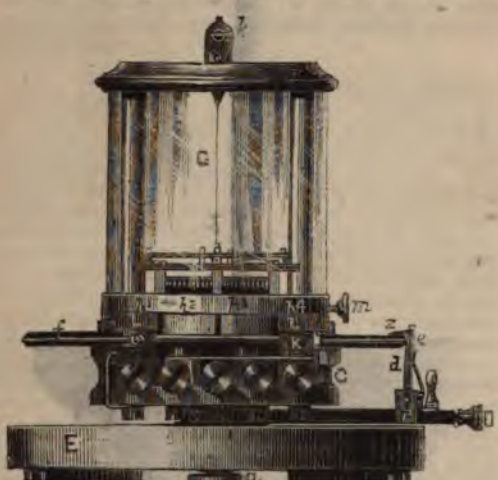


FIG. 13.

point. It has been found that in actual work, two men can drive the base-pile into stiff clay in about eight minutes.

Figs. 9, 10, and 11 show some of the forms of "INSULATORS" exhibited. Fig. 9 represents two insulators fitted with iron caps and excentrics, the latter by being turned round grip the wire tightly.

The "COMPOUND WIRE" exhibited consis tinned steel wire of the highest quality, a

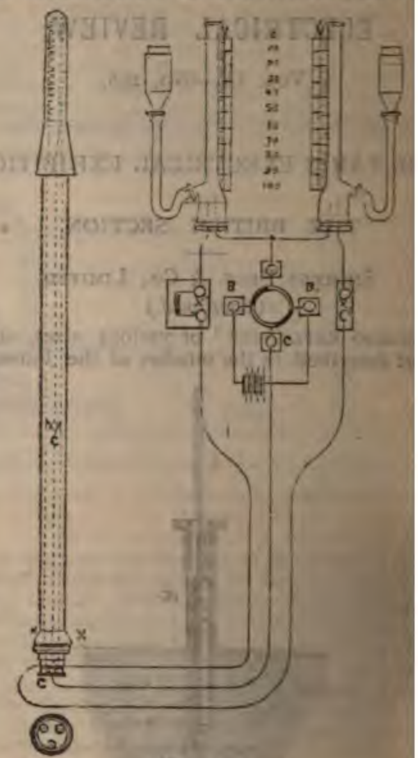


FIG. 14.

which a copper strip is wound helically; both and copper, having been drawn through a d plate, are firmly soldered together, and thus

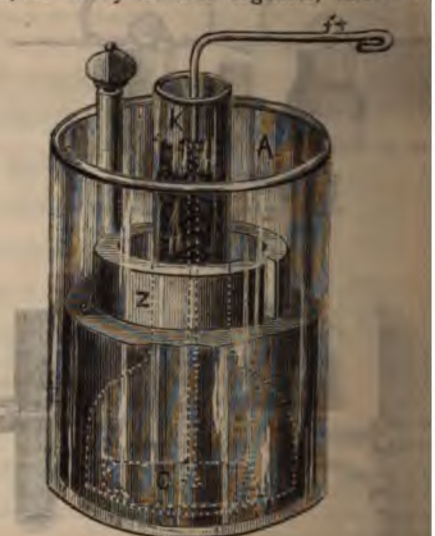
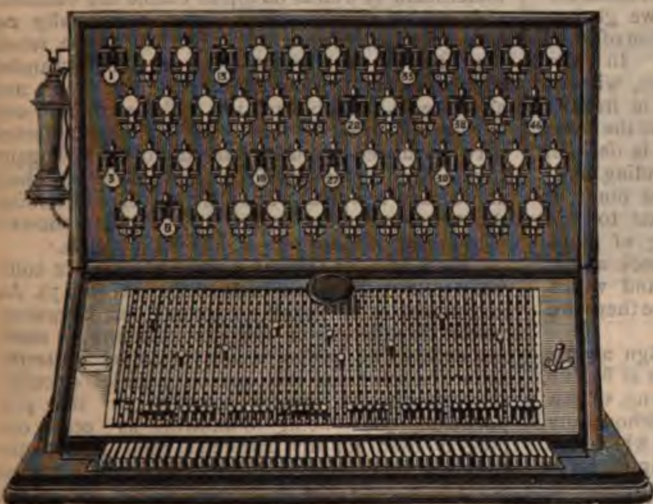


FIG. 15.

duce a compound wire, which combines light with strength and high conductivity; this c pound wire only weighs one-third of iron wi

equal electrical capacity. The joint for this wire is shown by fig. 12. It consists of a flat brass tube, *c*, the two ends of the wire are pushed into the tube at each end, and are opened out in the centre by a pointed steel drift; a rivet, *b*, is inserted in the hole thus formed, the ends of the wires are bent round outside the tube, and the entire joint is finished by soldering.

Amongst the "INSTRUMENTS FOR ELECTRICAL TESTING" are sets of resistance coils of the ordinary form, and also portable apparatus, a Thomson's galvanometer, with portable folding lamp and scale stand for same, a Jacob's transparent scale, for reading the mirror indications behind the scale instead of in front, as is usually the case. "Obach's galvanometer," which is shown, has been fully described in the number of the Journal for August 1st, 1879. "SIEMENS' UNIVERSAL GALVANOMETER," which is represented by fig. 13, has been described in the number of the Journal for January 1st, 1874; this instrument is a very useful



one, and enables resistances, electromotive forces, and current strengths, to be measured with a considerable degree of accuracy. The "ELECTRICAL PYROMETER," shown by fig. 14 (*see also* TELEGRAPHIC JOURNAL, October 15th, 1873) is for the purpose of measuring temperatures by ascertaining the resistance of a wire at the unknown temperature, the resistance at a known temperature being given; the resistances are measured by a differential voltameter.

For electric light measurements, resistances of carbon and also of hoop iron are shown.

The telegraph instruments exhibited are of the ordinary patterns, and do not call for any particular remark.

Amongst the "BATTERIES," are specimens of the Siemens and Halske constant cell (fig. 15). This battery, which was introduced some years ago, consists of an outer glass jar, A, at the bottom of which rests a porous bell-shaped cell, with a glass-tube, K, cemented into the cylindrical top of the cell; the positive pole is a piece of bent sheet copper, to which a copper wire, *f*, is rivetted; paper pulp, *e*, saturated with a strong solution of salt, is firmly pressed down over the porous cell and around the glass tube to about half the height of the outer jar, this paper pulp forms the diaphragm, and is covered at the top with a disc of blotting paper or flannel. Crystals of sulphate of copper are placed in the bell jar, and acidulated water in the jar, A, so as to cover the zinc.

J. A. RUDGE.

Mr. J. A. Rudge, of 1, New Bond Street Place, Bath, exhibits an "ELECTRO-MAGNETIC AIR PUMP," and also a "MEDICAL ELECTRIC BRUSH OR RUBBER." This latter piece of apparatus can be used either by the patient or the attendant on the latter, and supplies a want felt by the medical profession, as it is so portable that it can be carried in the pocket. It is a genuine electrical generator, and can be regulated to give any required strength of current.

The instrument, which is shown by the figure, consists of a steel magnetised frame, S, with a

Siemens' armature, A, between its poles. This armature is put in motion by the brush or rubber, which is connected to the same by a train of wheels; the latter are electrically connected to one end of the wire on the armature by a spring; the other end of the wire is connected to the frame. Terminals are fixed to the apparatus, to which wires can be attached leading to any part of the body required to be operated on. The brass frame, F, is insulated from the magnet by insulating material, M. The rubber or brush, R, when rubbed on the skin generates the current by causing the armature to revolve. The whole of the mechanism of the apparatus is inclosed in a mahogany case, so that nothing but the rubber is seen.

EDWARD PATERSON.

The exhibits of Mr. E. Paterson, of St. Paul's Works, 76, Little Britain, Aldersgate Street, comprise "Electric signalling instruments," "Telephones and telephonic apparatus" of various descriptions, and the new "Electric light measuring apparatus" of Professors Ayrton and Perry.

In "Electric signalling instruments" for domestic use, for hotels, ships, mines, &c., the exhibitor claims no particular features of novelty, unless good sound workmanship and reasonable prices may be considered such.

The telephone exhibits comprise ebonite telephones, with single and double poles, and Gower-Bell loud-speaking telephones, of which Edward Paterson has been the sole maker up to the present, with one or two unimportant exceptions. Probably one of the most successful installations of telephones is that of three Gower-Bell loud-speaking telephones, supplied to M. Houzean, of the Royal Observatory, Brussels. The instruments are used to connect the observatory with two of the fourteen meteorological stations, distant 80 and 110 miles, respectively. These are found to be perfectly satisfactory and to answer admirably.

The "carbon transmitters, with double pole ebonite telephones," which are shown, form a very good substitute for the Gower-Bell loud-speaking instruments.

The "Central apparatus for a telephone exchange" of 50 subscribers, of which we give an illustration, has for its object the promotion of rapid putting through at the central station. In cases where a subscriber calls, the attendant, without taking the plug out, depresses the key in front of the board, and on being told the number of the other subscriber with whom communication is desired, rings that subscriber up by his corresponding key; all that is now necessary is to shift the plugs of two subscribers from the bottom E bar to one higher up. This obviates the shifting of plugs from earth bar to telephone bar, and back again, which is necessary on other systems, and which involves a delay very objectionable where there are many subscribers.

In order to supply colonial and foreign agents Mr. Paterson has opened a branch house at 8, Rue Martel, where telephone material is made up, so that such orders can be executed promptly without any of the irritating delays and restrictions which the patent laws of England impose on the manufacturer who simply desires to export a patented article to countries where no patent exists, the English patent laws differing in this respect from those of nearly all other countries to the prejudice of the manufacturer, and without any benefit accruing to the patentee.

The exhibits in "Electric light testing apparatus" comprise Professor Ayrton and Perry's "Portable dead beat galvanometer" (*see* Telegraphic Journal, June 1st, 1881), also their "Dynamometer," their "Dispersion photometer," and their "Dynamometer coupling."

Joseph Bourne and Son.

We have to call attention to an error in our description of the exhibit of the above firm, which we gave on page 353 of the last number of the Journal; the material of which the insulators, &c., are constructed was stated to be "*porcelain*": it should have been "*stoneware*." That Messrs. Bourne should have succeeded in producing such fine specimens of the latter material is a highly creditable fact.

Elliott Bros.

The exhibit of Messrs. Elliott Bros., of 101, St. Martin's Lane, Charing Cross, is conspicuous for the excellence of workmanship and finish for which this firm of electrical instrument makers is so well known. The most important of the instruments shown are the following:—

"Slate resistance coils" (fig. 1). These are specially intended for powerful currents. The wires are wound round a number of slates in the box, and the box is perforated that air may have free access to the wires. The convolutions of the bare German silver or iron wires are kept separate from each other by being wound on the serrated edges of the slates.

"Four-dial platinum silver resistance coils with thermo-coils" (fig. 2). A great advantage in these sets is, that in all tests there are never more than four plugs (one in each dial) used at a time. Each set or dial can be used quite independent of the others, and, between each set, channels are made underneath as well as on top to enable the vulcanite slab to be readily cleaned, this is especially necessary when the coils are used for cable work. The bridge is connected by a stout stranded copper wire. Inside the resistance box, and as close as possible to the coils, a thermo-coil is inserted, this coil has its extremities connected to two insulated terminals at the side of the mahogany tray. The thermo-coil has a resistance of 100 ohms at a certain temperature and is used for determining the temperature inside the box. Fig. 2A shows a plan of one of these sets of coils with 5 dials.

"Four dial platinum silver resistance coils with bridge wire and communicator" (fig. 3). An instrument very suitably arranged for laboratory work. It differs from the previous one in many respects. The bridge is not arranged in series, as in the previous set, but in parallel circuits; this permits of greater accuracy in the proportional coils being obtained, as only one plug is used for any particular coil. Besides the coils a bridge wire is added, this gives a means of determining the resistance of any coil in the apparatus to an accuracy of two, three, or four decimal places, and consequently enables an unknown resistance to be determined to a similar degree of accuracy. A commutator is added to enable the mean readings of the bridge wire to be obtained with facility. On the right hand of the bridge, one additional block and plug may be observed, this serves to exclude the bridge wire, when the resistances in the bridge are not equal, but have a ratio of 1 to 10, 1 to 100, &c. The unknown resistance can be inserted on either side of the apparatus. This is often of great convenience.

"Portable unifilar magnetometer (figs. 4 and 5). Kew pattern, for determining the horizontal intensity of the terrestrial magnetic force and also the declination.

This instrument is mounted like a theodolite and consists of two parts, one serving for the deflection and the other for the vibration and declination. In the present improved form of the instrument two magnets and one telescope only are required for all determinations, whereas the older instruments have three magnets and two telescopes, making the instruments and the working with them

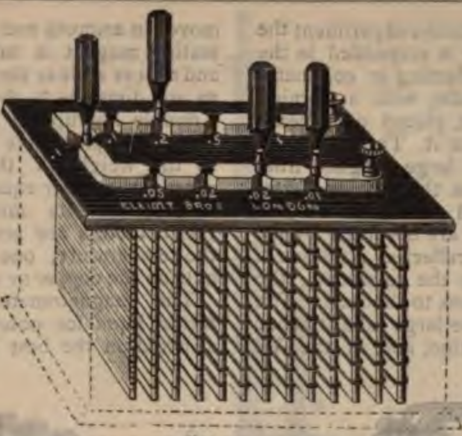


FIG. 1.

FIG 2.

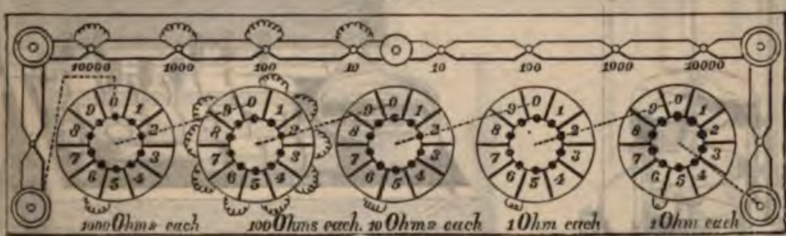


FIG. 2A.

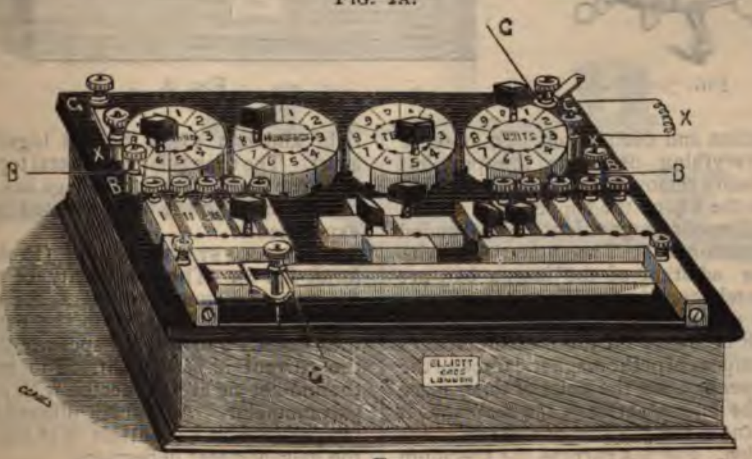


FIG. 3.

more complicated. For the *deflection* experiment the small magnet with its mirror is suspended in the copper box, and the large deflecting or collimator magnet is placed in the cradle, with a vernier, which slides on a divided bar, placed underneath the copper box at right angles to it. The deflections which are produced by the large magnet from various definite distances from the east and west side (either when the marked or unmarked end faces the suspended magnet) are observed by the telescope which receives the reflected divisions of the ivory scale placed above the telescope; the scale is gradiated to 100 divisions to the inch. The telescope rests in V's inside the large tube attached to the copper box for deflection, and in the V's moves in azimuth and altitude), is used. The collimating magnet is tubular with a lens at one end and a cross scale at the other; this scale is graduated to 400 divisions to the inch. The magnet rests in a double stirrup for the reception of the inertia bar. Two plummets are provided, one being equal to the weight of the collimating magnet and stirrup, the other equal to the weight of the small magnet with its mirror and mountings. Two thermometers are provided for the observation of the temperature, one placed inside and the other outside the copper or mahogany box.

The magnetometer is usually placed on a *tripod stand* for observation. This stand is constructed on the best principles, it is very firm and

FIG. 6.

FIG. 9.

FIG. 7.

FIG. 8.

outside for vibration and declination. To observe *the vibration* everything used for the previous determination, being removed, the wooden box has to be secured to the top of the copper box, and in the latter the collimator magnet is to be suspended by its own torsion-head. The vibrations, with and without the addition of the inertia bar, are observed by the telescope in the V's on top of large tube. The two observations of deflection and vibrations are both necessary for the measurement of the horizontal component of the magnetic force of the earth, as this depends upon the units of time, space and mass. For the determination of the *declination* it is necessary to know the position of the sun at the time of observation. For this purpose the speculum *transit mirror* above the counterpoise (which light and can easily be put together and taken apart. The triangular gun-metal top, packs separate from the legs. One of the legs has a metallic case or tube holding the long bar used in the deflection experiments.

"TEN OHM STANDARD COIL" (Professor Chrystal's form, fig. 6). The peculiarity of this coil is that the wire is wound round a thermo-couple in a narrow flat tube, to take up the external temperature quickly and to lose speedily the temperature the current imparts to it. The terminals of the thermo-couple are connected with a low resistance galvanometer. Any small difference between the temperature in or outside is at once indicated by the galvanometer deflections.

The "SETS OF PLATINUM SILVER COILS," with and

FIG. 4.

FIG. 5.

without bridge are of the ordinary type of resistance coils. The *megohm* is constructed for currents of high tension; the megohm of platinum silver wire is divided into four sections, each section having its ends connected to terminals on vulcanite pillars to insure better insulation.

All the "Condensers" (⅓ and ½ microfarads capacity in circular, and the subdiv. condensers in oblong boxes) are of the usual construction.

The "Marine galvanometer" is of the ordinary description, viz., Soft iron case, 1 in. thick—circular coil of fine wire of about 500 to 700 ohms resistance—fixed permanent magnet close round the coil, and two magnets moved by rack and pinion perpendicular to the magnet on back of mirror; either the N or S pole is pushed forward by the rack and pinion. The magnet and mirror have a double suspension in a frame (which slides down between the two halves of the coil), and are balanced so that the rolling and pitching of the vessel does not affect or interfere with its working. The silk is kept taut by a spring at one end of the suspension, at the other a simple arrangement is provided to bring the mirror and magnet concentric with the coil, if they should have moved by the elongation of the silk fibre, and to get the torsion out of the silk fibre.

The "B. A. unit or ohm" is of the general type.

The "Quadrant electrometer" (fig. 7). This is a modification of Thomson's, and is a very delicate and useful instrument, one Daniell's cell giving 100 divisions deflection on the scale (the Thomson's will give about 300 divisions). The Leyden jar can be easily removed for charging or changing the acid by sliding the quadrant with the slow motion quite out, after having loosened the connecting wire between the corresponding opposite quadrant and taking out the spring in the slow motion.

"Captain Bucknill's apparatus for testing lightning conductors" (fig. 8) is a very compact set of resistance coils with a small horizontal galvanometer, a small bridge with equal resistances and a ratio of 1 : 10 and a contact key.

"Latimer Clark's differential galvanometer" is of the usual construction.

The "Sub-divided ohm" has the following subdivisions:—·1, ·2, ·2, and ·5 ohms.

The "100,000 ohms resistance box" (fig. 9), is formed in four sections of 10, 20, 30, and 40 thousand ohms respectively; each section is quite independent of the others, a convenience often most useful in testing.

THE ELECTRICAL CONGRESS AT PARIS.

During the last month this Congress has held several meetings; the principal subject discussed has been the advisability of adopting a uniform and international system of electrical units. The committee have agreed to recommend to the Congress a system based on that arranged by the British Association, making the ohm the unit of resistance (as it is at present). The exact value of this unit is to be determined in terms of the Siemens' mercury unit, *i.e.*, it will be defined by the length of a column of mercury of a square millimetre in section. There can be no doubt but that the mercury standard is the most satisfactory one to adopt, as any number of standards of pure mercury at any particular temperature, and of definite dimensions, will have exactly the same resistance value, since mercury, unlike solid metals, has under the foregoing conditions exactly the same molecular structure, and the latter does not vary by lapse of time. The units of "current" and "electro-motive force" will remain as at present defined by the British Association Committee, but the former will be called in future the "ampère," whilst to the unit of "quantity," *i.e.*, that amount of electricity which a capacity of 1 farad (the unit of "capacity") charged to a potential of 1 volt (the unit of "electromotive force") will contain, will be called the "coulomb." The committee on "photometry" have been discussing the question of a standard of luminous intensity, but as yet without a final decision. Colonel Webber, R.E., spoke in favour of the candle employed in England, which, he maintained, burned steadily in every well-appointed photometric room. Mr. Warren Delarue suggested that in the tests and trials of the juries, on the present occasion, the Carcel lamp should be used in compliment to the French people; and it is understood this suggestion will be adopted, and that at a future sitting the question will be referred to an international committee for mature deliberation. The Congress have nominated the following gentlemen as English members of the juries:—Mr. Warren Delarue, Major Armstrong, R.E., Mr. Shelford Bidwell, Mr. Crompton, M.S.C.E., Mr. Crookes, F.R.S., Professor Everett, F.R.S., Professor Forbes, Mr. J. F. Moulton, F.R.S., Mr. W. H. Preece, F.R.S., and Mr. A. Stroh. The total numbers of the jury have been finally settled as follows:—France, 75; Belgium, 11; Great Britain and Ireland, 10; Germany, 10; the United States, 7; Italy, 10; Sweden, 5; Switzerland, 4; Spain, 3; Norway, 3; Holland, 3; Hungary, 1; Denmark, 1; and Japan, 1.

THE BRITISH ASSOCIATION.

ELECTRIC ENERGY.

By Dr. C. W. SIEMENS, F.R.S.

(Read before the British Association, September, 1881.)

(Continued from page 352.)

Against this expenditure has to be placed the saving of fuel effected in suppressing the stoves for heating the greenhouses, the amount of which I have not been able to ascertain accurately, but it may safely be taken at two-thirds of the cost of coal for the engine, thus reducing the cost of the fuel per light to 1d. per hour; the total cost per light of 5,000 candles will thus amount to 6d. plus 1d., equal to 7d. per hour. This calculation would hold good if the electric light and engine-power were required during, say, 12 hours per diem, but inasmuch as the light is not required during the daytime, and the firing of the boiler has nevertheless to be kept up in order to supply heat to the greenhouses, it appears that during the daytime an amount of motive power is lost equal to that employed during the night. In order to utilise this power I have devised means of working the dynamo-machine also during the daytime, and of transmitting the electric energy thus produced by means of wires to different points of the farm where such operations as chaff cutting, swede slicing, timber sawing, and water pumping have to be performed. These objects are accomplished by means of small dynamo machines, placed at the points where power is required for these various purposes, and which are in metallic connection with the current-generating dynamo-machine near the

engine. The connecting wires employed consist each of a naked strand of copper wire, supported on wooden poles, or on trees, without the use of insulators, while the return circuit is effected through the park railing or wire fencing of the place, which is connected with both transmitting and working machines, by means of short pieces of connecting wire. In order to insure the metallic continuity of the wire fencing, care has to be taken wherever there are gates to solder a piece of wire buried below the gate to the wire fencing on either side. As regards pumping the water, a three horse-power steam engine was originally used, working two force-pumps, of 3½-inch diameter, making 36 double strokes per minute. The same pumps are still employed, being now worked by a dynamo-machine weighing 4 cwt. When the cisterns at the house, the gardens, and the farm require filling, the pumps are started by simply turning the commutator at the engine station, and in like manner the mechanical operations of the farm already referred to are accomplished by one and the same prime mover. It would be difficult in this instance to state accurately the percentage of power actually received at the distant station, but in trying the same machines under similar circumstances of resistance with the aid of dynamometers as much as 60 per cent. has been realised. In conclusion, I have pleasure to state that the working of the electric light and transmission of power for the various operations just named, are entirely under the charge of my head gardener, Mr. Buchanan, assisted by the ordinary staff of under gardeners and field labourers, who probably never before heard of the power of electricity. Electric transmission of power may eventually be applied also to threshing, reaping, and ploughing. These objects are at the present time accomplished to a large extent by means of portable steam engines, a class of engine which has attained a high degree of perfection, but the electro-motor presents the great advantage of lightness, its weight per horse-power being only 2 cwt., while the weight of a portable engine, with its boiler filled with water, may be taken at 15 cwt. per horse power. Moreover the portable engine requires a continuous supply of water and fuel, and involves skilled labour in the field, while the electrical engine receives it food through the wire (or a light rail upon which it may be made to move about) from the central station, where power can be produced at a cheaper rate of expenditure for fuel and labour than in the field. The use of secondary batteries may also be resorted to with advantage to store electrical energy when it cannot be utilised. In thus accomplishing the work of a farm from a central power station, considerable savings of plant and labour may be effected; the engine power will be chiefly required for day work, and its night work, for the purposes of electro-horticulture, will be a secondary utilisation of the establishment, involving little extra expense. At the same time the means are provided of lighting the hall and shrubberies in the most perfect manner, and of producing effects in landscape gardening that are strikingly beautiful.

THE ELECTRIC DISCHARGE THROUGH COLZA OIL.

By A. MACFARLANE, M.A., D.Sc., F.R.S E.

(Read before the British Association, Sept., 1881.)

THE electrical properties of colza oil which I have examined, are its dielectric strength, and some phenomena which accompany the passage of the spark. By the dielectric strength of a substance I mean the ratio of the difference of potential required to pass a spark through the substance to that required to pass a spark through air under the same conditions. The electrodes used were two parallel brass plates, each 4 inches in diameter. When comparing the gases, the standard distance of the plates chosen was 5 mm. In the case of liquids it is convenient to observe from a shorter distance, and reduce the result by the law which previous experiments of mine have established, namely, that in the case of the discharge between parallel plates through a liquid dielectric the difference of potential required is proportional to the distance between the plates. (Trans. R.S.E., vol. xxix. p. 563.) One set of observations gave the ratio for colza oil to be 2·7; another gave 2·5. Hence 2·6 may be taken. The specific gravity of the colza oil is ·91. I have now obtained the following table of dielectric strengths for liquids (air being unity).

Substance.	Dielectric Strength.	Reciprocal of Relative Striking Distance.
Paraffin Oil.........	3·7	...
Oil of Turpentine...	4·0	16
Paraffin (liquefied).	2·4	...
Olive Oil............	3·5	...
Colza Oil............	2·6	...
Ether.................	...	7·8
Spirit of Wine......	...	8·0
Absolute Alcohol..	...	12·0
Water................	...	11·6

The values given in the third column were published by Masson. He found by the method of Faraday the relative striking distance for the substance with respect to that for air, and the entry gives the reciprocal of that ratio. He used balls for electrodes; in such a case the difference of potential is proportional, not to the distance between the balls, but to the square root of that distance. In the case of oil of turpentine, which has been examined by both methods, this relation is verified exactly.

The passage of the spark was accompanied by the formation of gas-bubbles, but there was no deposition of solid particles. As the four-inch plates were placed horizontally in the oil, a bubble produced by a discharge was prevented from escaping by the upper plate. When the upper plate is again electrified, such a bubble behaves in the following manner: If it is large enough, it will extend itself between the plates; but if it is smaller it takes the form of an acorn with a flat base, the base resting on one or other of the plates. When the upper plate is charged positively, the bubble is repelled so as to place its base on the lower plate; when the electricity is changed to negative the bubble remains with its base on the upper plate. A reversal of the order of the charging did not change the effect. After a few electrifications a sufficient number of solid particles collects to form a chain; and thus interferes with the phenomenon, the bubbles then being lengthened out in a remarkable manner, but never repelled to the lower plate.

When the upper plate was charged negatively, gas bubbles appeared to me to rise from the lower plate, as if they had been formed there. To test this point further I took some sparks between two smaller discs placed vertically in the oil. The gas-bubbles were observed to rise up at the negative surface, as if they had been formed at the positive surface, and had been repelled or carried straight across and then rose up at the negative surface. When the spark was taken between two points bent at right angles to two rods dipping into the oil, the bubbles were observed to shoot

out in the direction from the positively charged point, and to circulate round the earth-rod before rising to the surface. These phenomena indicate that the bubble is positively electrified.

ON THE APPLICATION OF ELECTRICITY TO THE LOCALISATION OF A BULLET IN A WOUND.

By W. H. PREECE, F.R.S.

(Read before the British Association, Sept. 1881.)

ANY application of electricity that can aid the practice of surgery and lead to the total suppression of pain, must fulfil one of the highest functions of the art of applying the great forces of nature to the wants of man.

I purpose to show how an electric current can be made an invisible and immaterial probe, localising the position of a bullet without touching the human body or inflicting the slightest sensation of pain. Electricity has already been used for probing purposes, but only to detect, by the ringing of a bell, the fact that a metallic mass has been touched by the point of the instrument. The operation was performed, with all its pain to the wounded sufferer, and electricity was employed only as an agent more sensitive than the touch.

The conception of using electricity alone as the tool itself for this purpose occurred to Professor Graham Bell in Washington. He telegraphed to me on the subject to consult with Professor Hughes as to the use of his induction balance for the purpose. Professor Hughes threw his whole heart into the matter. Full directions were sent out to Professor Bell, who was independently experimenting on the subject with Mr. Tainter. Experiments were made by him upon President Garfield, and there is every reason to believe that the position of the bullet has been unmistakeably localised.

(Mr. Preece then proceeded to describe the principle of the induction balance generally, and also of the apparatus devised for the special purpose of localising the position of a bullet in a wound. The description was similar to that given on page 317 of the number of the Journal for August 15th.)

The apparatus admits of much variation in form, and I have no doubt that Professor Hughes will shortly devise a practical form which can be placed in the hands of any surgeon.

Professor Bell and Mr. Sumner Tainter have worked assiduously at the matter, and have considerably modified the instrument and increased its sensitiveness. They have extended its range to five inches. Professor Bell's report to the surgeons in attendance on President Garfield is interesting:—"I beg to submit for your information a brief statement of the results obtained here with the new form of induction balance, in the experiments made this morning for the purpose of locating the bullet in the person of the president. The instrument was tested for sensitiveness several times during the course of the experiments, and it was found to respond well to the presentation of a flattened bullet at a distance of about four inches from the coils. When the exploring coils were passed over that part of the abdomen where a sonorous spot was observed in the experiments made on July 26th, a feeble tone was perceived, but the effect was audible a considerable distance around this spot. The sounds were too feeble to be entirely satisfactory, as I had reason to expect from the extreme sensitiveness of the instrument, a much more marked effect. In order to asecrtain whether similar sounds might not be obtained in other localities, I explored the whole right side and back below the point of entrance of the bullet; but no part gave indications of the presence of metal, except an area of about two inches in diameter, containing within it the spot previously found to be sonorous. The experiments were repeated by Mr. Tainter, who obtained exactly corresponding results. We are, therefore, justified in concluding that the ball is located within the above-named area. In our preliminary experiments we found that a bullet, like the one in question, which in its normal shape produced no audible effect beyond a distance of 2½ inches, while the same bullet flattened and presented with its face parallel to the plane of the coils, gave indications up to a distance of nearly five inches. The same flattened bullet, held with its face perpendicular to the plane of the coils, produced no sound beyond a distance of one inch. These facts show, that in ignorance of the actual shape and mode of presentation of the bullet to the exploring instrument, the depth at which the bullet lies beneath the surface cannot be determined from our experiments."

This shows that much remains to be done to render the instrument practical and useful; but, nevertheless, we have clear evidence of a new application of electricity, which will be beneficial and valuable.

SOME OF BELL AND TAINTER'S RECENT RESEARCHES, AND THEIR CONSEQUENCES.

By WM. LANT CARPENTER, B.A., B.Sc., F.C.S.

(Read before the British Association, Sept., 1881.)

THE author described in general terms the experiments of Messrs. Bell and Tainter, intended to prove that sonorousness was a universal property of matter, when submitted to the influence of an intermittent beam of light, and he described particularly their instrument for determining and comparing the limit of sonorousness of any particular substance, and of any particular molecular condition and colour of that substance (*e.g.*, porous bodies were more sonorous than dense, dark coloured than light, &c.) It had occurred to the author that if, instead of using two receivers with different substances under the same intermittent beam, the same substance were used and two different beams employed, the comparative intensities of these beams might be arrived at by the limit of sonorousness of the receiver under the influence of any particular intermittent beam. In fact, that a photometer might thus be constructed, in which light intensities (or rather radiant energies) might be compared by listening to the sounds produced when intermittent beams from the lights fell upon a standard sensitive receiver. Rough experiments, in which Dr. S. P. Thompson had assisted the author, gave ground for the correctness of this view, but the instrument would not be at all a delicate one.

A CONTRIBUTION TO THE HISTORY OF SECONDARY BATTERIES.

By Dr. C. W. SIEMENS, F.R.S.

(Read before the British Association, Sept., 1881.)

THE surprising effects realised by Faure give particular interest at the present time to the general subject of secondary batteries and, it may not be uninteresting to

ccount of some early attempts in this direction :h I have been connected.
rliest and, as regards its principle of action, : perfect and admirable form of secondary ;, he ventured to think, that proposed by Sir Grove as early as 1841. It consisted, as is rn, of two test tubes with a strip of platinised suspended in each from an electrode passing :he tube, the two tubes dipping with their open a trough filled with acidulated water.
ssing a galvanic current through such a rogen is developed in the one tube and oxygen ier in the well-known proportions, and if the e disconnected, and the electrodes be connected of a wire, with a galvanometer of high resis- will be found that a continuous current is pro- :ceeding a Daniell element in electro-motive ich current continues to flow until the whole of accumulated previously in the tubes by means lvanic current have recombined. The current ced necessarily equals that by which the de- ion was effected, barring only losses by e, which, in the case of Grove's gas battery, the utmost reduction. The drawback to any use that could be made of the Grove gas is that the active surface of triple contact the metal, the acidulated water, and the gas is gly small, and consequently that the amount of o be got from such a battery in a given time o small for practical use.
year 1852 the problem was put to me whether modification of the Grove gas battery, it would ossible to obtain larger effects, and, applying o the question, I undertook a series of experi- he results of which were embodied in a report, as deemed satisfactory at the time, but has een published. Now, however, these results :o reassume some practical value. Starting Grove battery, I endeavoured to obtain a form ode presenting a large surface of triple contact. appeared ill-suited for the attainment of object, and I consequently directed my attention n, such as is deposited in gas retorts, as being :r material, and one that, owing to its porosity ghness of surface, seemed well calculated for :lopment of surface action. Two pieces of bon inserted into inverted glass tubes similarly rips of platinum already referred to, gave rise its of larger quantitive effect, although some- ferior in intensity to those produced by the strips. The intensity, however, was greatly d by subjecting the carbons previous to use to s of platinisation, or galvanic deposition of ent platinum on their surfaces. The next step ut carbon into the shape of tubes open at one closed at the other. A number of these tubes erted in a square box of gutta-percha in rows ig the box alternately in one direction and the ie box being ultimately placed edge-ways and ed with two chambers covering respectively the ds of the two series of tubes. By filling these mbers, the one with oxygen, the other with hy- gas, and filling the square box containing the th acidulated water, I succeeded in converting re carbon surfaces into surfaces of triple contact n, acidulated water, and oxygen and hydrogen ectively, owing to the porosity of the material ibes; and it was only necessary to connect the osed and protruding ends of the tubes by means in order to constitute the arrangement of a gas of considerable power. Nevertheless, the cur- insufficient for my purpose, though care had cen to platinise the tubes.

With a view of increasing the potential of the cur- rents, I directed my attention to the peroxides of metals, and soon found that peroxide of lead was the one giving the greatest promise of results. The tubes were plunged, after drying, into a strong solution of acetate of lead, then dried and heated to a dull redness, and again immersed in the lead solution. After repeat- ing this process several times, they were placed in position, and a strong battery current was passed through them, by which the lead was converted into peroxide. The increase of current resulting from this mode of treatment was so remarkable that I was able to effect the decomposition of water by means of one such carbon-lead gas battery by connecting it to a voltameter. No reliable methods of ascertaining the potential of the current were available at that time, but, judging by the results, the power of two volts must have been reached.

It was, however, found difficult to obtain a supply of carbon tubes of the right degree of porosity, and I therefore fell back on a simpler form of battery, con- sisting of two bars or rods of dense carbon, upon each of which a long series of thin laminæ of porous carbon, pierced laterally by holes to admit the carbon rod, were strung, a certain distance between the laminæ being insured by washers of the same material. Two such bars of carbon with their laminæ were placed side by side in a cylinder of gutta-percha with a dividing diaphragm of porous clay, and constituted, when impregnated with peroxide of lead, a powerful galvanic cell. The power of the cell depended more, however, on the power and time of application of the exciting current than upon the gases admitted into the cylinder, showing that it was chiefly due to the presence of the peroxide of lead formed by the exciting current.

These exciting currents produced by a Grove nitric- acid battery were, however, too expensive to render the secondary battery available for practical purposes, whereas by the use of dynamo currents, results might have been obtained comparable to those obtained by means of the Faure battery. By the substitution of porous carbon for sheet lead in the secondary battery of the present day, the intervening layers of felt would be dispensed with, and a large amount of active surface be aggregated in a comparatively small space.

THE PROPER PROPORTIONS OF RESISTANCE IN THE WORKING COILS, THE ELECTRO-MAGNETS, AND THE EXTERNAL CURRENTS OF DYNAMOS.

By Sir WILLIAM THOMSON, F.R.S.
(Read before the British Association, Sept., 1881.)

If R be the resistance of the electro-magnet, R_1 the resistance of the working coil, then the question is, how ought R and R_1 to be proportioned to make the ratio of waste to work a minimum. For the ordinary dynamo, the result of the investigation shows that R_1 should be somewhat greater than

$$\frac{R + R_1}{2}$$

the exact value depending upon the magnetic sus- ceptibility of the iron in the machine, the forms, magnitudes, and relative positions of the wire on the machine, &c., &c., quantities which cannot be deter- mined theoretically. In the shunt dynamo, if E be the resistance connecting the terminals of the machine, then it is best to have approximately $E = \sqrt{RR_1}$.

ON SOME USES OF FAURE'S ACCUMULATOR IN CONNECTION WITH LIGHTING BY ELECTRICITY.

By Sir W. THOMSON, F.R.S.

(Read before the British Association, Sept , 1881.)

THE largest use of Faure's accumulator in electric lighting was to allow steam or other motive power and dynamos to work economically all day, or throughout the twenty-four hours where the circumstances were such as to render this economical, and storing up energy to be drawn upon when the light was required. There was also a very valuable use of the accumulator in its application as an adjunct to the dynamo, regulating the light-giving current and storing up an irregular surplus in such a manner that stoppage of the engine would not stop the light, but only reduce it slightly, and that there would always be a good residue of two or three hours' supply of full lighting power, or a supply for eight or ten hours of light for a diminished number of lamps. He showed an automatic instrument which he had designed and constructed to break and make the circuit between the Faure battery and the dynamo, so as automatically to fulfil the conditions described in the paper. This instrument also guarded the coils of the dynamo from damage, and the accumulator battery from loss, by the current flowing back, if at any moment the electromotive force of the dynamo flagged so much as to be overpowered by the battery.

ON THE ECONOMY OF METAL IN CONDUCTORS OF ELECTRICITY.

By Sir W. THOMSON, F.R.S.

(Read before the British Association, Sept., 1881.)

THE most economical size of the copper conductor for the electric transmission of energy, whether for the electric light or for the performance of mechanical work would be found by comparing the annual interest of the money value of the energy lost in it annually in the heat generated in it by the electric current. The money value of a stated amount of energy had not yet begun to appear in the City price lists. If £10 were taken as the par value of a horse-power night and day for a year, and allowing for the actual value being greater or less (it might be very much greater or very much less) according to circumstances, it was easy to estimate the right quantity of metal to be put into the conductor to convey a current of any stated strength, such as the ordinary strength of current for the powerful arc light, or the ten-fold strength current (of 240 webers) which he (Sir William Thomson) had referred to in his address as practically suitable for delivering 21,000 horse-power of Niagara at 300 miles from the fall.

He remarked that (contrary to a very prevalent impression and belief) the gauge to be chosen for the conductor does not depend on the length of it through which the energy is to be transmitted. It depends solely on the strength of the current to be used, supposing the cost of the metal and of a unit of energy to be *determined*.

Taking the cost of copper at £70 per ton, and the cost of horse-power the same as above, then if the electric work is carried on through a conductor for 12 hours of every day in the year, it would be most economical to have a wire whose sectional area is about one-fiftieth the strength of the conveyed current in webers.

ILLUMINATING POWERS OF INCANDESCENT VACUUM LAMPS WITH MEASURED POTENTIALS AND MEASURED CURRENTS.

By Sir W. THOMSON and JAMES T. BOTTOMLEY.

(Read before the British Association, Sept., 1881.)

THE electro-motive force used in these experiments was derived from Faure secondary batteries, kindly supplied for the purpose by the Sociétié la Force et la Lumière in their London office.

Two galvanometers were used simultaneously, one called the *potential galvanometer* for measuring the difference of potentials between the two terminals of the lamp, the other (called the current galvanometer), for measuring the whole strength of the current through the lamp.

The potential galvanometer had for its coil several thousand metres of No. 50 (B.W.G.) silk-covered wire (of which the copper weighs about $\frac{1}{10}$ gramme per metre, and therefore has resistance of about 3 ohms per metre). Its electrodes were applied direct on the platinum terminals of the lamp.

The current galvanometer had for its coil a single circle of about 10 centimetres diameter of thick wire placed in the direct circuit of the lamp, by means of electrodes kept close together to a sufficient distance from the galvanometer to insure no sensible action on the needle except from the circle itself. The directive force on the needle which was produced by a large semi-circular horse-shoe magnet of small sectional area was about $2\frac{1}{2}$ c.g.s., or 15 times the earth's horizontal magnetic force in London. This arrangement would have been better for the potential galvanometer also than the plan actually used for it, which need not be described here. The scale of each galvanometer was graduated according to the natural tangent of the angle of deflection, so that the strength of the current was simply proportional to the number read on the scale in each case.

Three lamps were used, Nos. II. and III. of a larger size than No. I. The experiment was continued with higher and higher potentials on each lamp till its carbon broke.

The illuminating power was measured in the simplest and easiest way (which is also the most accurate and trustworthy), by letting the standard light and the lamp to be measured shed their lights nearly in the same direction on a white ground (a piece of white paper was used); and comparing the shadows of a suitable object (a pencil was used); and varying the distance of the standard light from a white ground till the illuminations of the two shadows were judged equal. The standard used was a regulation "standard candle," burning 120 grains of wax in the hour. The burning was not actually tested by weighing; but it was no doubt very nearly right; nearly enough for our purpose, which was an approximate determination of the illuminating powers of each lamp through a wide range of electric power applied to it. The following results were obtained.

LAMP No. I.

No. of Experiment.	Cells	Volts.*	Webers.	Volts × webers × 10 = kilogrammetres.	Horse-power.	Candles.	Candles per horse-power.
1	26	56·9	1·21	6·88	·093	11·6	125
2	30	65·5	1·46	9·56	·129	25	194
3	32	70·2	1·64	11·51	·156	42	263
4	33	71·8	1·74	12·48	·170	38	224
5	34	74·1	1·81	13·42	·181	44	243
6	35	76·1	1·82	13·86	·187	55	294
7	36	78·0	1·99	15·52	·210	63	300
8	37	80·3	2·06	16·54	·224	66	295
9	38	81·9	2·06	16·88	·228	76	333
10	39	84·6	2·06	17·43	·235	82	349
11	40	87·0	2·10	18·27	·247	84	340
12	42	90·9	2·17	19·72	·267	102	382
13	44	92·0	2·17	19·96	·270	89	330
14	46	99·1	2·21	21·91	·296	114	385
		Carbon of lamp broke with same power, immediately after the measurement of the light was completed.					

LAMP No. II.

No. of Experiment.	Cells.	Volts.	Webers.	Volts × webers × 10 = kilogrammetres.	Horse-power.	Candles.	Candles per horse-power.
1	40	89·7	2·207	19·8	·27	49	181
2	42	93·3	2·296	22·42	·29	68	234
3	43	95·4	2·38	22·71	·31	76	245
4	44	98·8	2·49	24·60	·33	101	306
5	46	103·0	2·63	27·09	·37	117	316
6	50	106·9	2·74	29·29	40	147	367
7	52	110·8	2·85	31·56	·43	189	440
8	54	117·0	2·95	34·53	·47	196	417
9	56	119·8	2·95	35·34	·47	186	388
10	58	121·8	2·98	36·29	·49	177	361
11	40	87·0	2·14	18·62	·25	35	140
12	42	89·7	2·24	20·09	·27	42	156
13	60	122·8	3·06	37·58	·51	186	365
14	62	126·0	3·13	39·44	·53	180	340
15	66	132·4	3·24	42·89	·57	222	383
16	70	Carbon of lamp broke.					

LAMP No. III.

No. of Experiment.	Cells.	Volts.	Webers.	Volts × webers × 10 = kilogrammetres.	Horse-power.	Candles.	Candles per horse-power.
1	40	82·3	2·85	23·45	·31	68	219
2	50	101·8	3·90	39·70	·54	195	361
3	60	Carbon of lamp broke.					

Some of the irregularities of the results in the preceding tables are very interesting and important, as showing the effect of the blackening of the glass by volatilisation of the carbon when too high electric power came to be applied.

The durability of the lamp at any particular power must be tested by months' experience before the proper intensity for economy can be determined.

* The volt is approximately equal to the difference of potentials corresponding to 9⅓ Daniell's cells.

ROTATIONAL CO-EFFICIENT IN METALS.

By Dr. E. H. HALL, of Baltimore, U.S.

(Read before the British Association, September, 1881.)

THIS paper had reference to a discovery made about two years ago at the John Hopkins University, Baltimore, by which it was shown that when a conductor bearing a current of electricity is subjected to a magnetic force at right angles to the direction of the current a transverse electro-motive force is set up in this conductor, the direction of the transverse force being perpendicular to the plan of the primary current and the magnetic force. The term "rotation co-efficient," as here used, means the transverse electro-motive which would be set up in a conductor of square section of unit area, bearing the unit electric current, when acted upon by the unit magnetic force. Several articles upon this subject have already been published; but the present communication gives some newly discovered facts connected with the matter.

Sir Wm. Thomson said this was by far the most important work of the sections.

ELECTRIC LIGHTING FOR COAL MINES.

By ANDREW JAMIESON, C.E.

(Read before the British Association, September, 1881.)

MR. JAMIESON said that in the discussion which followed the exhibition of Swan's lamp at the *soirée* of telegraph engineers in October last, Professor Tyndall remarked that probably this form of incandescent lamp could be adapted for use in coal mines as a safety lamp. Since then two practical trials had been made with that object in view—one at Pleasley Colliery, near Nottingham, by Messrs. R. E. Crompton & Co., in conjunction with Swan's Electric Light Company, about the middle of June; the other at Earnock Colliery, near Glasgow, by Messrs. D. and G. Graham, of Glasgow, for Mr. Watson, the proprietor, on August 9 and 11. These trials had created not only a scientific, but also a commercial as well as a general and public interest. The circumstances in which the lighting had to be produced and maintained were new, and differed in many respects from those in which it was now being carried out above-ground in our halls, houses, and open spaces. Dangers and difficulties peculiar to the situation had to be guarded against or overcome, such as explosive gases, subsiding walls or seam roofs, continuous darkness, &c. Long lengths of leading wire had to be dealt with, involving many branches or offshoots, requiring considerable mechanical skill and still more electrical knowledge before a suitable distribution of the electric current was effected and the desired uniformity and intensity of light obtained. Particular interest was at present being manifested by mine owners, managers, and engineers to know the commercial value of the light, or, in other words, whether the possible increased light and safety of Swan's lamps over the methods hitherto adopted would result in an economy and in an

increased output of coal for the same expense of labour. Again, a general and public interest was always awakened in this country when anything was done or even attempted to be done for the benefit of our fellow-creatures, and more especially when this attempt was directed in aid of men who toiled from morning to night or night to morning in the ever dark, dingy, and dismal bowels of the earth in order to provide us with the means of supplying ourselves with coal. Mr. Jamieson reviewed in detail what had been done at Pleasley and Earnock Collieries, explaining the apparatus and appliances adopted at the latter by means of a large wall diagram, which he had made from a scale plan kindly sent to him by Mr. Gilchrist, the manager of Earnock. He showed working models of strong miners' lanterns encasing Swan's lamps, and of air-tight contact-makers of various designs and patterns for preventing the inevitable spark (which always takes place upon disconnecting leading wires or lamps), from causing danger in a fiery mine. He pointed out and showed by calculation and sketches on the blackboard that the plan of joining up another of Swan's lamps in single parallel with a self-exciting Gramme, Siemens, or other form of dynamo-machine, was neither the most economical nor handy for management from the fact that the lamps required to be specially ordered and made a slightly decreasing resistance in proportion to their distance along the main leads from the generator, and that without a costly and delicate current-regulator, there was considerable risk of spoiling the remaining lamps upon turning out a number of them. He said the plan of introducing an equivalent resistance to that of the lamps turned out was equivalent to throwing away so much energy or coal, because the resistance so introduced absorbed power equal, in fact, to that of the lamp or lamps which it replaced. Finally, he gave several plans for joining up the lamps which, in his opinion, were more economical and better; and he stated that by using Siemens' dynamo excitors with their alternate current machines, the danger accruing from suddenly turning out a number of lamps was avoided, as the electromotive force remained practically constant with a low resistance lead and generator coil, and therefore the current passing the remaining lamp or lamps was always the same. For example, if 49 lamps out of 50 were suddenly switched out of circuit, the remaining lamp would not be endangered, and would have the same current passing through it and give the same light as before. He reviewed in detail the most approved mechanical and electrical apparatus for installing electric lighting in coal mines, and mentioned that he had found by experiment that good Swan lamps would give forth light at the rate of 220 candle-power per horse-power absorbed by them.

THE LACHAUSSÉE-LAMBOTTE DYNAMO MACHINE.

By A. GUEROUT.

THE "lampes soleil," which are in action at the Palais de l'Industrie in the picture-gallery and in the Belgian section beneath the south gallery, are worked by a peculiar form of machine devised by MM. Lachaussée and Lambotte, of Liège.

A machine of this description is exhibited beneath the south gallery, close to the alternate current Gramme machines, and another pattern a little further off, under the same gallery. This machine is represented in perspective by fig. 1.

It is composed, like the alternating current machine of Siemens, of a disc of bobbins of an oval form (fig. 2) placed between two circular rows of electro-magnets. But in the Lachaussée machine it is the electro-magnets and not the oval bobbins which are movable, besides, these last have plates of soft iron as a core, and consequently themselves constitute true electro-magnets of a special form.

The connecting parts of these bobbins and of the pieces necessary to support them, form a drum occupying the centre part of the machine. From edge to centre these oval bobbins are held between two discs of wood screwed on a central axle; towards the circumference they are fixed in grooves in movable pieces of wood, P (fig. 2), themselves set in openings in the ring of wood which forms the outside of the drum.

In this way the pieces of wood can easily be taken out, and the bobbins can be easily withdrawn from the drum and changes or repairs made as required. The extremities of the wire of each bobbin are fixed to two pieces of copper, where they are secured by screws. To these same pieces are fixed also the wires, B, B', which pass together under a lining of brass surrounding the drum and fixed by the upper part of the machine to terminals set on a plate; the same arrangement is adopted for all the bobbins, and each one of them has beneath the upper plate a pair of terminals which correspond to them. Six strong tie-pieces support this drum from each side, and maintain it at an equal distance from two supports, which form the base of the machine.

The inducing electro-magnets, 12 on each side, are mounted on two plates fixed to an axis and movable with it. The current arrives at the inductors by two brushes, and these inductors are joined up in tension so that two consecutive electro-magnets have always contrary poles, and so that the poles of two magnets, facing each other on either side of the drum, are likewise of opposite polarity.

The apparatus is completed by a small Gramme machine which excites the inductors. Finally, large oil cups keep the bearings properly oiled.

As the outside wires of each bobbin correspond to two of the terminals of the upper plate, it is easy to group these bobbins in various ways. At the exhibition the groups are so arranged that one bobbin is taken for one lamp, two bobbins for two lamps, and so on. In this arrangement, care must always be taken to couple together those bobbins which, at the same moment, are traversed by currents of the same kind; and if there are two consecutive bobbins which at the same moment are traversed by currents of a reverse kind, the connection must be made on to the terminals, so that these currents flow together. At the Palais de l'Industrie, one of these machines works 12 "lampes soleil," with an arc of 20 millimetres. The power absorbed according to a measurement made by MM. Wezer and Richmond, is equal to 24 horses.

The principal advantage of the Lachaussée-Lambotte machine consists in the peculiar mounting of the induced bobbins, which allows of their being so easily replaced, and in the facility with which they can be grouped in various ways. The inventors call attention to the circumstance that the turning discs of the electro-magnets having a considerable mass prevent irregularities from the slipping of the driving belt.

On the other hand the rotation of these discs produces a very disagreeable roaring, but the inventors of the "lampe-soleil," who have a licence for the construction, at Paris, of the machine, and who have already made several improvements, think that there will be no difficulty in getting rid of the noise by inclosing the inductors in a peculiar kind of envelope. It is true

that the movement of the machine transmits, telephonically, a sufficiently great noise to the arc itself, but the stifling of this in the lamp renders the inconvenience insignificant.

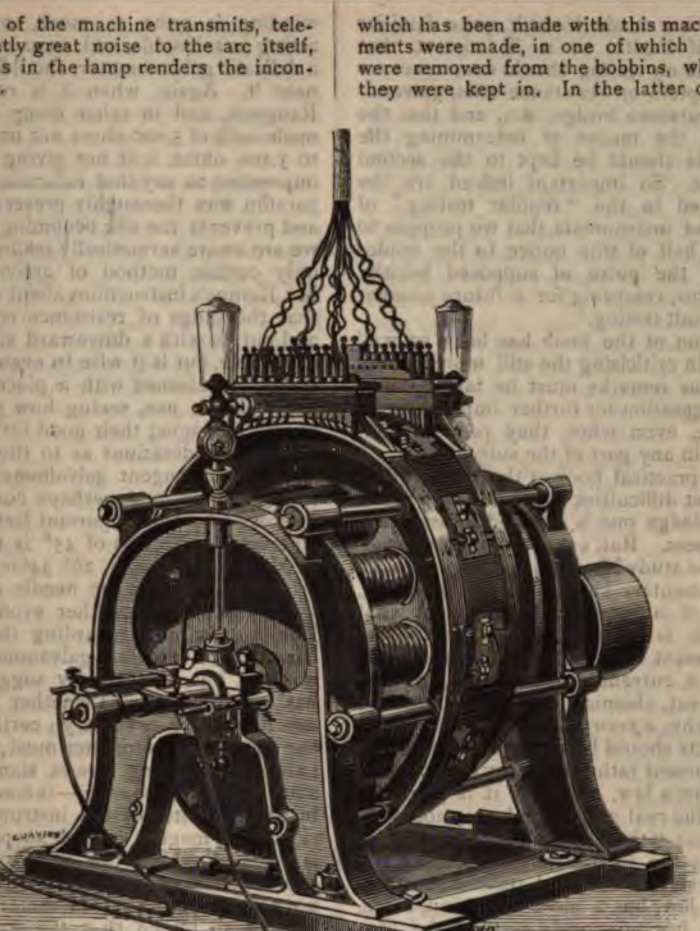


FIG. 1.

As regards the problem of obtaining the maximum effect with the least possible weight, it is certain that the Lachaussée-Lambotte machine is very far from a

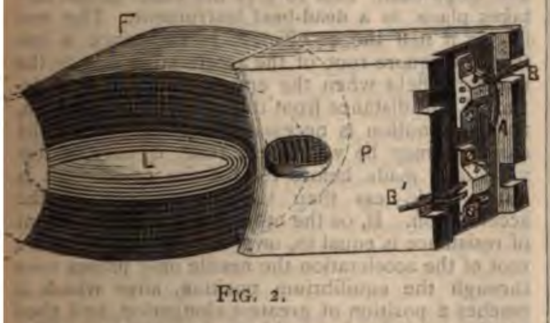


FIG. 2.

solution of the same, but there are cases where stability and ease of repair are qualities sought for, and from this point of view the machine possesses decided advantages.

We will conclude by referring to an experiment which has been made with this machine: two experiments were made, in one of which the soft iron bars were removed from the bobbins, whilst in the other they were kept in. In the latter case the effect was very much more powerful than in the former.—*La Lumière Electrique*.

[A Lachaussée-Lambotte machine and several "lampes-soleil" are at present at work at the Royal Aquarium, Westminster.—ED. *Tel. Jour.*]

Review.

A HANDBOOK OF ELECTRICAL TESTING.*

THE duties of a tester of telegraph lines may, like those of a doctor, be classed under two heads—the first the preservation of a healthy state—the second the prompt discovery and eradication of disease when it comes on. And just as it is proper that a medical student should not attempt the study of

*By H. R. Kempe. London, E. and F. N. Spon, 16, Charing Cross.

disease until he has made himself quite familiar with the laws of health, so it is correct that Mr. Kempe's book on testing should commence, as it does, with chapters on resistance coils, galvanometers, the Wheatstone bridge, &c., and that the consideration of the modes of determining the positions of faults should be kept to the second half of the book. So important indeed are the methods employed in the "regular testing" of telegraph lines and instruments, that we propose to confine the first half of this notice to the modes used for feeling the pulse of supposed healthy electrical apparatus, reserving for a future number the subject of "fault testing."

The first edition of the book has been so well appreciated that in criticising the still more perfect second edition our remarks must be taken rather in the light of suggestion for further improvements than as dispraise, even when they propose considerable change in any part of the subject.

In writing any practical book at the present day, one of the greatest difficulties is to know how much elementary knowledge one is justified in assuming the reader to possess. But, even although we may assume those who study Mr. Kempe's book to have at least some elementary knowledge on electricity, we think that if it is necessary to tell them what Ohm's law is, it is certainly necessary to also explain what is meant by the strength of a current. For, seeing that a current produces many totally distinct effects, heat, chemical action, &c., there is no more reason why, *à priori*, the magnitude of any one of these effects should be selected as the mode of measuring a current rather than any other. The writer quotes Ohm's law, much as it is given in other books, but the real gist of the law is not made clear. To say that "the strength of the current varies directly as the electro-motive force of the battery and inversely as the total resistance in the circuit" is not a law, but a mere definition, since, unless a student has previously grasped the idea that electromotive force and resistance are things, the magnitude of which have no connection with the particular strength of current employed, and unless he has a clear conviction that ordinary galvanoscopes do not *measure* currents by the degrees marked on them, he will quite fail to realise the spirit of Ohm's law. When, for example, it is said that the resistance of the electric arc equals the electromotive force between the carbons divided by the current, this is not an example of Ohm's law since it is a mere definition of the resistance of the arc. Resistance in such a case is a mere name given to a ratio—electromotive force divided by current—which for the same distance between the carbons actually varies with the current. Although resistance unlike electromotive force cannot be measured without a current flowing through the circuit, still the pith of Ohm's law depends on the resistance of a conductor being regarded as having a sort of independent existence quite apart from the current.

Under the head of resistance coils, the author says, the object of the "double winding" is to eliminate the induced current. But surely, remembering that with the ordinary bridge key the current is first sent through the coils before the galvanometer is put into circuit, and thus the effects of self-induction are avoided, the double winding is quite as much to prevent the coils acting as solenoids, and so causing a deflection on a delicate galvanometer, should they happen to be near it. Again, when it is remembered that in Rangoon, and in other damp countries, carefully made coils of 5,000 ohms not unfrequently go down to 3,500 ohms, is it not giving a student a wrong impression to say that saturating the "coils in hot paraffin wax thoroughly preserves their insulation, and prevents the silk becoming damp?" As far as we are aware hermetically sealing up the coils is the only certain method of arriving at this result. Mr. Kempe's instructions about attention being paid that the plugs of resistance coils are quite clean and put in with a downward screwing motion are admirable, but is it wise to even hint that the plugs should be cleaned with a piece of glass, or emery paper before use, seeing how great is the chance of thus damaging their good fitting?

The considerations as to the best deflections to use with a tangent galvanometer are clearly and forcibly given, and perhaps could only have been improved by the important fact being added that, whereas a deflection of 45° is the angle that gives maximum sensibility, 26° 34′ is that for which the error arising from the needle not being infinitely small vanishes altogether even for long needles. The instructions regarding the setting up of a Thomson's reflecting galvanometer are clear and minute, but instinctively suggest that the writer has not himself tried whether all the precautions mentioned are necessary; certainly we know that the rule—a galvanometer must be set "so that the two front levelling screws stand north and south, and the front faces east"—is considered unnecessary by the inventor of the instrument. Again if the regulating magnet can be so placed "that a point is reached where the earth's magnetism is just counterbalanced," will not a student ask why should not a single needle galvanometer with the regulating magnet so placed that the earth's magnetism is almost just balanced, be as sensitive as an astatic combination? Indeed the relative advantage of a single needle in a weak field, and an astatic combination in a stronger field, we do not remember to have ever seen treated in any book.

The statement that in a "dead-beat" galvanometer "the mirror, instead of over-shooting the mark and then recoiling turns straight to its proper position and stops dead" fails to give the exact action that takes place in a dead-beat instrument. The real fact is if half the co-efficient of resistance is less than the square root of the acceleration due to the magnetic field when the end of the needle is deflected unit distance from the equilibrium position, then the motion is necessarily oscillatory, but the damping may be very great (that is, only a few vibrations made before rest) if the co-efficient is but a little less than the square root of the acceleration. If, on the other hand, the co-efficient of resistance is equal to, or greater than the square root of the acceleration the needle only passes once through the equilibrium position, after which it reaches a position of greatest elongation, and then returns towards the position of equilibrium which it never reaches. But in no case can it be said "not to overshoot the mark and turn straight to its proper position and stop dead."

Chapter IV. on shunts as well as the description

in Chapter XI. of the error arising from the use of shunts in measuring capacity (and which is so important that it merits a special reference in the index) is remarkably good; indeed the author has made the subject of shunts so throughly his own that any student who wishes to throughly grasp this subject should refer to Mr. Kempe's book.

The paragraph on page 52, "If we employ very high resistances to measure a low resistance, a considerable alteration in the former would produce but little alteration in the current flowing through the galvanometer," is one beginners should take to heart so as not to fall into their habitual error of attempting to weigh a few grains of dust with a weighbridge suitable for weighing a railway truck, an error which appears absurd enough when put in that form, but which is constantly being made in electrical measurements from a beginner forgetting that a small coil of 5,000 ohms bears to the resistance of a bit of thick wire about the same proportion that a ton bears to the weight of a few grains.

Thomson's method of measuring the resistance of a galvanometer without the employment of an auxiliary galvanometer is carefully considered, and "the best condition for making the test," as well "as the possible degree of accuracy attainable," entered into at considerable length, but we do not see it mentioned that the method must necessarily in practice be only comparatively rough, seeing that if the galvanometer be sensitive an extremely weak current must be used, otherwise the deflection will be off the scale, in fact this test has the objection that was possessed by the old method of testing with an electrometer the insulation of a cable by loss of charge. If the electrometer was sensitive the potential to which the cable was charged had to be very small, and, although a larger potential could be employed if the electrometer was more unsensitive, the rate of motion of the spot of light over the scale was not, of course, thereby increased. Prof. Jenkins' inferred zero method, described by Mr. Kempe, on page 227, was devised to overcome this difficulty; but we do not think attention is quite sufficiently drawn to the fact that its whole value consists in its affording a means of using a high potential with a delicate electrometer and so of obtaining a high degree of sensibility.

Chapter VI., on the measurement of the internal resistance of batteries, is extremely complete, and here, as in all other parts of the book, the author calculates in each case the "best conditions for making each test" and "the possible degree of accuracy attainable," but we cannot help noticing what must strike a reader when reading almost any portion of this work, viz., that a valuable addition might have been made by giving a quick indication as to which of the many methods described should be practically employed in any particular case. The same remark applies to Chapter VII., on the "Comparison of the Electromotive Forces of Batteries." and which contains a carefully written account of some ten distinct methods of performing this test, for we fear that in this *embarras de richesses* a student would feel himself quite unable to select the method he ought to adopt.

Chapter VIII., on "the Wheatstone's bridge," is very complete and contains a large amount of very valuable information. As in other parts of the book there is a frequent reference to the work done by people in England—we presume it is patriotism which has prevented Mr. Kempe referring to the additions made to our knowledge of the Wheatstone's bridge by foreigners, especially by Mr. Schwendler of the Indian Government Telegraph Department, who has taken so active a part in devising methods of testing and in carrying them out, in fact, in reducing the testing of telegraph lines to a science. But we venture to think that the "equilibrium method," page 148, the calculation of the proper resistance to give to a galvanometer in a Wheatstone bridge, page 311, &c., which are usually attributed to Mr. Schwendler should either have been credited to him or a misconception removed by the real names of their authors being given.

We agree with the author in his precautions, page 176, "Particular care should be taken, when procuring the keys, to see that the terminals, &c., are not fixed on the top of the ebonite pillars by means of bolts running right through them, as in such a case the advantage of the pillars is entirely lost, and the terminals might just as well be screwed direct into the base board." We would have liked him to add—nor should a hole be ever bored right through an ebonite pillar, since although the screw holding on the terminal at the top does not touch the screw which is put in from below, to fasten the ebonite pillar to the base board, still the sides of the hole may possibly be dirty with oily brass particles, so that no cleaning of the outer surface of the ebonite can possibly make the pillar insulate. Another wise precaution, it would be well to add, is that all the connections in a high insulating key should be above the base board and quite clear of it, since good surface insulation of a pillar is useless if there are badly insulated connecting wires imbedded in the base.

"A very convenient form of condenser, manufactured by Messrs. Warden," sounds antique, and the suggestion that "the shunts should be inclosed under the glass shade so that they may have the same temperature as the galvanometer coils" is, we fear, not a sufficient precaution against the error likely to arise from the considerable change in the resistance of copper wire arising from a small change in temperature.

Under the head of "Joint Testing" it is stated, on page 262, that "when possible it is best to make joint tests by means of an electrometer as the results are always more trustworthy than those obtained by the condenser method," since they are free from the error arising from a small residual charge in the condenser. But surely the great value of the electrometer when used for joint testing arises from the fact that *potential* and not *quantity* is measured. It may require a considerable quantity of electricity to leak from the joint into the insulated joint trough and attached condenser before a decided deflection could be obtained with even a delicate galvanometer, whereas if the joint trough has, like the quadrants of the electrometer, a small capacity, the smallest leakage through the joint raises the potential of the insulated trough, and becomes noticeable.

On page 315, under "Specification for Manufacture of Cable," we find a "coating of Chatterton's compound being placed next the conductor and between each layer of percha." But would not an electric engineer of the present day rather forbid than require the employment of Chatterton's com-

pound? Again "an electrometer test for fall of charge is also sometimes taken as a check," hardly represents the system of testing now employed, seeing that all the tests both for insulation and for capacity, made by the engineers, of all the coils used in the construction of some long submarine cables, have been performed by the aid of an electrometer only.

After reading carefully the many chapters of this book on normal testing (those on fault testing will, as already mentioned, form the subject of a future article), we find ourselves filled with admiration at the large amount of most valuable information this book contains, but at the same time we do not think Mr. Kempe has done himself justice, since there are indications of an apparent absence, either of actual practice in testing or in imparting information to students, for whom of course such a book is specially intended.

September. W. E. AYRTON.
JOHN PERRY.

Correspondence.

ELECTRIC LIGHT.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—In your Journal for the 1st inst. I notice that "Electron" seems to question whether the incandescent lamp really possesses true illuminating power at all; yet he states that they are perhaps suited "for the small cabins of ocean steamers." A visit to the Paris Exhibition, where he will see many of the Swan lamps, will perhaps convince him that they do possess some illuminating power. Further, he states that the "20 horse-power engine which drives 60 lights on the Thames Embankment of over 200 candle-power each would hardly, I believe, suffice to drive 40 incandescent lamps." If this be so, all that I can add is, that electrical lighting in London must be very far behind what we have in the north. I know of a certain form of dynamo-machine which will, with an expenditure of 20 horse-power (actual) light 200 of Swan's lamps and furthermore do so without the slightest flicker, also there is no heating of the armature.

As to "Electron's" statement about the illuminating power of the lamps sold, they must be judged by the space lit up. The proof of the pudding is in the eating.

If the lamp referred to by "Electron" was tested by the ordinary Bunsen photometer, the results obtained may be accounted for, as it is useless in testing any light over 100 or 150 candle-power.

Yours truly,
JOHN E. CHASTER.

35, Ward's Buildings, Deansgate, Manchester.

Notes.

ELECTRIC LIGHT IN THE FRENCH LIGHTHOUSES.—Four of the most important French lighthouses have already been provided with very powerful electric apparatus and with machinery for furnishing sound signals during stormy or misty weather. It is proposed to apply similar apparatus to the forty-two others. The total cost is estimated at 7,000,000f. (1,400,000 dols.) for the electricity, and 1,000,000f. (200,000 dols.) for the fog horns. This expenditure is very light in view of the protection which it will afford to the immense capital represented by the 225,000 ships which annually visit the French harbours.—*Les Mondes.*

ARCTIC TELEGRAPH LINE.—The new submarine cable, the most northerly in Europe, is to be laid between Thurso, in Caithness, and Iceland, passing by the Faroe Islands. The chief office in Iceland will be at Reikiavik, and the line will connect with Stappen, the chief town of the Vester-Amt, and with the Madruvel, in the Norder-Amt. The estimated cost of the cable, the plans for which have been prepared at Copenhagen, is about £260,000.

NEW PORTABLE BATTERY.—A very compact and powerful battery has been recently patented by Mr. Marcus A. Hardy, of Newport, R.I. It is designed for medical and experimental purposes, and is very convenient and portable. The battery comprises twenty elements, and the cells are made in one entire piece of hard rubber, which is known to be indestructible with proper use. The construction of the battery is such that all of the cells can be filled in twenty seconds from the reservoir forming the base, and the exciting fluid remains in contact with the zincs and carbons only during use. Any number of cells, from one to twenty, may be brought into use as may be required. The battery cell forms the top to a hollow base or reservoir, and from each cell a small tube projects into the hollow base nearly to the bottom. To the base at one end is attached a stopcock, to which is connected a rubber tube terminating in a mouthpiece. At the opposite end of the reservoir there is a screw-capped opening for introducing the exciting liquid. The zinc and carbon plates are attached to brass connecting pieces secured to a common support of hard rubber. The connections are arranged so that the zinc of one cell is in electrical communication with the carbon of the next, and so on throughout the series, and plug connections may be inserted to cut out any number of cells. The fluid is forced into the cells by blowing on the tube, and is retained by turning the cock. The battery power is greatly augmented by blowing fluid into the cells and allowing air to rise in bubbles around the electrodes. This battery is used in torpedo service, and is extremely well adapted to laboratory use.—*Scientific American.*

EDISONIA.—Mr. Edison has, it is said, offered to light some shops at the West-end with incandescent lamps for six months free of all charge.

The great Edison dynamo-machine, which it is said will maintain 1,400 lights, has arrived in Paris from America, and will be in the Exhibition in a few days.

THE ELECTRIC LIGHT BY THE FAURE BATTERY.—On the 16th ult. the first practical application of stored electricity to the lighting of interiors took place in the smoking-room of the Junior Carlton Club. The room is ordinarily lighted by a modified form of sun-burner, with about 25 gas-burners in it. Beneath this has been suspended a shade somewhat like the shade of an umbrella, and in this 15 British incandescent lamps are placed. The light given was very much superior to gas, and the illumination of the room was much purer and softer, and the light actually steadier than with gas. The electricity came from Faure accumulators which were placed in the basement of the building. These had been charged at the Heddon Street works of the British Electric Light Company, and had been brought into the club only a few hours before the lighting-up took place. Each cell of the accumulators is about 15 in. by 9 in. by 4 in. The number of cells was 40. They were sufficiently charged (by Gramme machines) to last about six hours. The light has been brought into the club through the desire of Mr. Martin,

etary, to give the members the advantages to ned from the use of incandescent lamps. The in the hands of the British Electric Light Com- 'hose engineer, Mr. Radcliffe Ward, personally ended the work. The result was pronounced ccessful.

GRAPHIC COMMUNICATION WITH LIGHTHOUSES. quisition, numerously signed, has been for- from Ramsgate to the Lord Mayor, requesting lship to convene a public meeting "for the pur- representing to her Majesty's Government the necessity of establishing telegraphic communi- rith the lightships, lighthouses, and the shores, h the object of preventing great loss of life ur coast from vessels shipwrecked or in dis-

ELECTRIC LIGHT IN NORWICH.—The Norwich Council have agreed to accept the tender of Crompton and Co., of London, for lighting of the principal streets of the city by means of ty for twelve months at a cost not exceeding It was stated that nearly one hundred gas- ould be superseded, and that the extra cost of t would be only about £100. The cost of this ent was, it was explained, less than half that ar experiments made elsewhere; and the ex- t already made in lighting the market-place red eminently successful.

GRAPHIC COMMUNICATION WITH RONALDSHAY. cial meeting of the Kirkwall Town Council l on the 24th ult., for the purpose of considering ect of telegraphic communication with South hay. The presence of the s.s. *Dacia* in the f Scotland was considered opportune for the f the five miles of cable necessary for the exten- d a memorial to the Postal authorities on the was decided on.

EE ELECTRIC LIGHT COMPANY.—At a meeting Dundee on the 21st ult., a provisional committee ointed to form an Electric Lighting and Power y in Dundee.

clerk to the Dundee Gas Commissioners l to a recent meeting, that he had communi- ith the English and Scotch electric light com- and the corporation, and that the general us of opinion received was to the effect that ric light could not and would not be brought eral use, and that the gas companies and com- rs should direct their efforts to utilising gas d more. After considering the whole matter, mittee resolved that no private companies or venturers should be allowed to supply the light y in Dundee, and that if the use of the electric s desired, the Commissioners should themselves t. With the view of ascertaining its suitability, cost of its production, they instructed experi- be made at an expense not exceeding £200.

MAXIM ELECTRIC LIGHT.—The Maxim electric about to be introduced into the sorting rooms Edinburgh General Post Office.

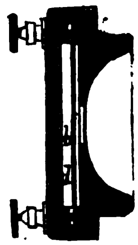
EXHIBITION.—A Gas Exhibition, similar to that held in Glasgow, was opened on the 19th ult., Marischal College, Aberdeen. The chief features n's electric light, and Pintsch's lighted buoy.

SWAN ELECTRIC LIGHT.—A comparative test luminating powers of the Swan electric light, and the Bray gas light, resulted in the former being declared the more brilliant, but at a cost four times that of the latter.

CANADIAN TELEGRAPHY.—A consolidation of Canadian telegraph lines, long talked of, has at last been accomplished. Henceforth what have been known as the Montreal and Dominion Companies will virtually disappear, both having been merged in the Great North-Western, with a view to placing themselves under the control of the Western Union Company of the United States.

TECHNICAL CLASS IN TELEGRAPHY.—A technical class in Telegraphy will be commenced on October 19th, by Mr. Macrae Keith, of the Superintending Engineer's Office of the Postal Telegraph Department, Edinburgh. The class is for the purpose of instructing the Post Office staff of the above town. The subjects dealt with will be:—"The construction, character and difference of the batteries employed in Telegraphy; the measurement of electrical quantities and the apparatus used; the systems in use to increase the capacity of wires for the conveyance of messages; the various modes of joining up circuits; faults—their nature, prevention, and localisation, &c." The formation of classes of this kind is a move in the right direction, and we hope that Mr. Keith's example will be followed in other towns.

MR. SUMNER TAINTER, of photophonic celebrity, has recently patented in the United States (No. 243,657, dated May 14th, 1881) the telephone transmitter shown by the figure. The invention consists of a



combination of a vibratory insulating plate with a layer of conducting particles and conductors, whereby the layer can be included in an electric current.

ELECTRIC PHENOMENA OBSERVED ON DRYING WAX-CLOTH.—H. Hottenroth.—Wax-cloth freely suspended in a drying-room, and exposed to a current of hot air, becomes electric, probably by the friction of the air.—*Dingler's Journal.*

CONSIDERATIONS ON ELECTROGENESIS.—By Signor Nicotra.—A conspectus of the contact, and electromotoric theory of the fundamental experiments, and of the formation of the current. Recent facts and views are not taken into account.—*Wiedemann's Beiblätter.*

POTENTIAL DIFFERENCE OF THE ELECTRIC STRATA WHICH COVER TWO METAL PLATES IN CONTACT WITH EACH OTHER.—M. H. Pellat.—With the decrease of pressure in all gases—air, oxygen, carbonic acid, hydrogen—the potential difference between copper and zinc increases. The change is greatest in oxygen, and slightest in hydrogen.—*Wiedemann's Beiblätter.*

SELENIUM PHOTOPHONE WITHOUT A BATTERY.—By H. Kalischer.—A pencil of rays is thrown upon a preparation of selenium by means of a heliostat or a lens, which is alternately covered by means of a revolving disc fitted with holes. On connecting the selenium apparatus with a telephone the latter sounds. The height of the tone increases with the speed of rotation of the disc. When direct sunlight falls upon the selenium preparation a galvanometer connected with it indicates a current. The lime-light is not strong enough. The introduction of an alum plate does not suspend the action, but a solution of iodine in sulphuret of carbon, as also coloured glasses other than yellow or light brown, have this effect.—*Weidemann's Beiblätter.*

ON THE CHANGES OF THE ELECTRO-MOTIVE FORCE AND THE RESISTANCE OF AN ACTIVE HYDRO-ELECTRIC ELEMENT.—By D. Mazzoto.—The author verifies the proposition that the electro-motor force decreases with the increasing intensity of the current by observations made on a Leclanché or a Volta element. If the parts of a Volta element containing the electrodes are connected with dilute sulphuric acid by means of a syphon the zinc-platinum element is the most variable and the zinc-carbon element the most constant. The magnitude of the changes in a zinc-copper or a zinc-platinum element is of the same order, whilst in a zinc-carbon element they are relatively much smaller and slower. The internal resistance increases as in other elements with an increasing external resistance, or a decreasing intensity of current. The zinc-copper element shows the opposite behaviour. The latter results differ from those obtained by Von Waltenhofen with the same elements; the latter, however experimented with weaker currents. *Wiedemann's Beiblätter.*

IMPROVEMENT IN THE COMPASS.—By F. Miller.—In order to read off more conveniently the position of the needle, there are fixed at its ends two thin horizontal discs of aluminium upon which is drawn a line coinciding with the axis of the needle. A microscope with a cob-web cross, made movable upon the graduated circle and fitted with a vernier, enables this line to be observed. In addition there are fixed at the ends of the needle two vertical discs of paper or mica, by whose friction against the air the vibrations of the needle are moderated.—*Dingler's Journal.*

ON THE QUANTITATIVE DETERMINATION OF THE DEVELOPMENT OF HEAT BY THE GALVANIC CURRENT.—BY E. EDLUND.—This determination can be easily effected, proceeding from the proposition formerly established by the author that the electromotive force if traversed by a current consumes or produces a quantity of heat according as the current moves in the same direction as its own direction of action or in the opposite, and that in either case the quantity of heat consumed or produced is proportional to the product of the electromotive force in the strength of the current.—*Wiedemann's Beiblätter.*

THE CITY AND GUILDS OF LONDON INSTITUTE.—The winter courses of lectures of the above institute will commence during the present month. The Technical Physics classes will be conducted by Professor Ayrton, who will lecture on "Electric lighting and the transmission of power," "Electrical instrument making," and, "Electrical laboratory apparatus."

As a special number of the *Journal* of the Society of Telegraph Engineers, a valuable Guide-Book to the British Section, at the Paris Electrical Exhibition has *been issued, edited by* Prof. W. E. Ayrton, F.R.S.

OZONE.—The abbé Moigno has suggested that in view of the enormous development of electricity that takes place from the running of so many dynamo-machines, in the Paris Exhibition, experiments should be made in the building to determine the effects of the currents in developing ozone in the atmosphere.

THE ELECTRO-TECHNICAL SOCIETY OF BERLIN.—The Electro-Technical Society of Berlin (*Electrotechnischer-Verein*) offers a prize of a thousand marks (shillings) for the best essay on the transmission of power by electrical and mechanical means, which must be sent in before the 1st of October, 1882.

ON THE ENERGY OF TELEPHONIC CURRENTS.—By M. Pellat.—A condenser of the capacity of $\frac{1}{3}$ microfarad was charged and discharged 160 times in a second by communication with two points of a circuit, into which a telephone was introduced. If C is the capacity, V the potential difference of the coatings, the energy will be $\frac{1}{2}$ C V², and for *n* charges and discharges the energy expended $= n$ C V². If V is reduced to 0·0005 volt, a sound is still heard in the telephone, though the energy is so small that it would require 10,000 years to produce a microcaloric, *i.e.*, to raise 1 grm. of water 1° C. With this small expenditure of heat a telephone can be made to sound for 10,000 years.—*Wiedemann's Beiblätter.*

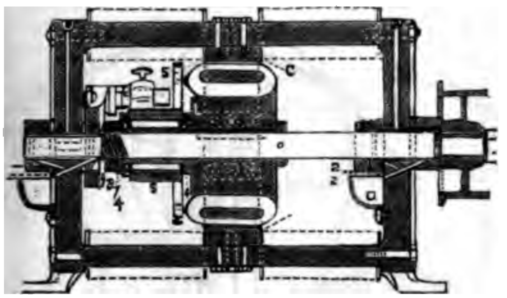
BRIGHTON EXHIBITION.—The exhibition of sanitary, domestic, and scientific appliances, to be held in the second week of December at Brighton, is to include also a competitive exhibition of electric lighting.

INTERNATIONAL ELECTRIC EXHIBITION AT THE CRYSTAL PALACE.—It is intended to hold an exhibition at the Sydenham Palace, from December next to March, 1882. Applications for space, English and foreign, should be made to the Manager, Crystal Palace. Printed forms of application for admission can be had from the Manager, Crystal Palace, Sydenham, London, or at the Hôtel Chatham, Rue Neuve St. Augustin, Paris. The principal objects to be admitted are comprised in the following:—*a.* Apparatus used for the production and transmission of electricity. *b.* Magnets, natural and artificial. Mariners' compasses. *c.* Applications of electricity. Exhibits will be received on and after 21st November, 1881. Exhibitors will not have any rent to pay, but must at their own expense place and decorate their exhibits. Motive power will be supplied free of cost to the exhibitors applying for it. The exhibitors must provide attendants for the proper cleaning of their exhibits and space. The expenses of removing and bringing back the cases will be borne by the exhibitors. The question of medals and certificates will be settled hereafter. It is a question whether the glory of the Paris Exhibition can in December be immediately transferred to the pleasure palace on the outskirts of London. One thing is certain, that the Crystal Palace management, to make success certain, should be as liberal as possible to intending exhibitors. It is reported, but we know not on what authority, that many promises have already been obtained from exhibitors at Paris. Some exhibitors at Paris will consider it little trouble to pass their exhibits from the one show to the other, whilst others will probably consider that for one year, at least, they have had enough of trouble and expense.

ELECTRIC LIGHTING BY WATER POWER.—An experiment was made at Godalming, on the night of the 26th ult., to light a portion of the town by electricity generated by a water wheel. One large Siemens' lamp and several of Swan's small incandescent lights were

in use, and the illumination was deemed highly satisfactory. It is proposed to fix turbines, which the little River Wey will drive at considerable velocity, giving power for a number of lights to supply the Charterhouse Schools, Godalming, and probably Guildford. In the daytime electricity can be stored in Faure accumulators.

A PATENT (No. 245,040 dated Feb 4th, 1881) for the magneto-electric machine, shown by the figure has been taken out in the United States by James J. Wood. The chief points in this machine relate to the commutator, which is composed of plates having their ends bevelled, the bevelled portion being held by grooved plates, the groove being filled with insulating material.



One of the grooved plates is attached to the tube which fits on the armature-shaft. The other plate is forced against the commutator-plates by a nut on the tube. Extensions from the commutator-plates are provided with binding-screws for the attachment of the armature wires.

New Patents—1881.

3926. "Secondary batteries or magazines of electricity." J. S. SELLON. Dated September 10.

3929. "An improved system of multiplex and self-convertible 'teleradiophone.'" E. J. P. MERCADIER. Dated September 10.

3932. "Dynamo or magneto-electric machines." P. JENSEN. (Communicated by T. A. Edison.) Dated September 10.

3944. "Improvements in telephones, in part applicable to other electrical apparatus." W. E. IRISH.

3946. "Telephones." W. E. IRISH. Dated September 12.

3975. "A new or improved mode of and appliances for carrying and laying electric wires." J. W. SMITH. Dated September 14.

3976. "Electric arc-lamps." P. JENSEN. (Communicated by A. J. B. Cance.) Dated September 14.

3987. "Secondary batteries or magazines of electricity." J. S. SELLON. Dated September 15.

4005. "Storing electricity." J. S. SELLON. Dated September 16.

4011. "Electric lamps." B. HUNT. (Communicated by A. E. Brown.) Dated September 17. (Complete.)

4017. "Improvements in electric lamps, in electrodes therefor and in fitting up the same." A. HALLETT. Dated September 17.

4019. "Generating dynamic electricity." G. E. DERING. September 17.

4024. "Electric lamps." W. MORGAN BROWN. (Communicated by E. M. Fox). Dated September 19.

4026. "Dynamo-electric and magneto-electric machines." E. DE PASS. (Communicated by La Société Anonyme des Câbles Electriques, système Berthoud, Borel et Cie.) Dated September 19.

4029. "A new construction of telephone transmitter." S. PITT. (Communicated by H. Machalski.) Dated September 19.

4034. "Dynamo or magneto-electric machines and electric motors." P. JENSEN. (Communicated by T. A. Edison.) Dated September 19.

4037. "Secondary batteries." W. CLARK. (Communicated by N. de Kabath.) Dated September 19.

4052. "Improvements in and relating to electrical alarm apparatus for the protection of dwelling houses or other structures or places from burglary." H. H. LAKE. (Communicated by H. C. Roome.) Dated September 20.

4057. "Improvements in the production and employment of continuous electric currents in railway carriages, steam-boats, and other vehicles and in apparatus to be used therefor." H. E. NEWTON. (Communicated by the Société Universelle d'Electricité Tommasi.) Dated September 20.

4058. "Improvements in and relating to electrical cables or lines for telegraphic, telephonic, and other purposes." W. H. LAKE. (Communicated by J. B. Henck.) Dated September 20.

4059. "Improvement in electrical bath apparatus to be used for the application of electricity to horses and other animals." H. H. LAKE. (Communicated by B. Barda.) Dated September 20.

4060. "Regulating the discharge of secondary and other batteries." A. M. CLARK. (Communicated by N. de Kabath.) Dated September 20.

4069. "Indicating apparatus or signals for railway switches or points." W. P. THOMPSON. (Communicated by W. W. Gary.) Dated September 21.

4070. "Indicating apparatus or signals for railway switches or points." W. P. THOMPSON. (Communicated by W. W. Gary.) Dated September 21.

4078. "Alarm signals for railway carriages and for other purposes." J. NORRIS. Dated September 21.

4093. "Electric cables." E. G. BREWER. (Communicated by P. B. Delany and E. H. Johnson.) Dated September 22.

4107. "An improved dynamo-electric machine." F. E. FAHRIG. Dated September 23.

4127. "An improved fire alarm wire or indicator." B. J. B. MILLS. (Communicated by P. A. Charpentier.) Dated September 24.

4128. "Methods or apparatus for distributing and regulating the transmission of electrical power." J IMRAY. (Communicated by M. Deprez and J. Carpentier.) Dated September 24.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1881.

200. "Transforming, conveying, &c., power by means of electricity," &c. JOHN IMRAY. (A communication from abroad by Gustave Eugène Cabanellas, of Paris.) Dated Jan. 15. 1s. Relates to means and apparatus for transforming, conveying, and applying power by means of electricity, the objects aimed at

being as follows — a. The distribution by a single conducting system among any number of consumers along the line of the energy disposable at various points, in such manner that the forms under which the energy is locally consumed may differ and that the local consumption may be increased, diminished, or arrested at the will of the consumer whilst nevertheless the regulation of all the local supplies of energy is subject to a single regulation effected automatically at the supply station, so arranged that the quantity of energy produced exactly suits the total demand along the line. b. The distribution by electricity over any distance and among any number of receivers of the speed and direction of prime movers in such manner that local receivers connected to one line can utilise predetermined movements in any number or direction, and at the same time distribute arbitrary local forces.

264. "Apparatus for producing light by means of electric currents," &c. ALFRED APPS. Dated Jan. 21. 6d. The invention consists of three parts:—1st. The object of this invention is to secure increased facilities for obtaining a correct measurement of the currents passing through an induction coil, primary, or other magnetic or induction apparatus, by the attachment of a special dynamometer constructed with gauge, and indicating in customary measurements of force the maximum power or variations of the currents or charges. 2nd. This part of the invention consists of the multitubular form and make of magnet and of conductor contained within the inductor, securing better insulation than heretofore. 3rd. The invention relates to the separation or arrangement of the currents or charges in the parts of the conductors in or about the induced field, and the utilisation of the discharges to produce light in passing through rods, filaments, tubes, or plates of carbon or carbonised material or other conducter placed between two holders, the lower one being stationary, and the upper drawn down by gravitation, and making by solid or fluid means a good metallic connection, the moving holder being held so as to secure the requisite axis of the parts. Fig. 1 represents in elevation the improved

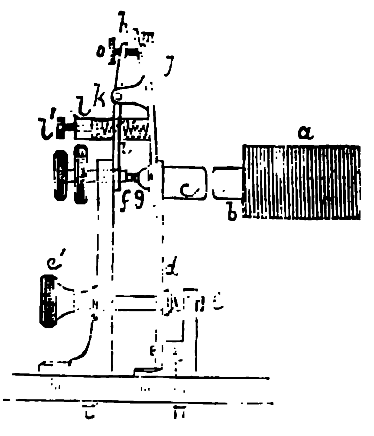


FIG. 1.

construction of dynamometer arranged according to the first part of the invention. In this fig. *a* is the primary or other coil, electrical or magnetic, but if the magnetic power be produced by other means, then the apparatus to measure and regulate the action is equally applicable. *b*, is an iron core opposite to which is the solid iron cylinder, *c*, or other suitable magnetic body fixed to the plate spring, *d*. This spring plate is pulled or drawn away from the core, *b*, by means of the tension screw, *e*, turned by its insulated head, e^1. The platinum studs, *f*, *g*, are by this means brought into contact. In order to know the force with which the studs, *f*, *g*, are pressed together the dynamometer, *h*, is employed; it is of the spring balance kind, and is constructed with two flattened arms, *i*, *j*, jointed at about one quarter part of the whole length distant from one end at *k*. In the central part of the dynamometer, *h*, is fixed a tube, *l*, containing a spiral spring which is forced up by a regulating screw, l^1. A little pin projecting from the end of the spiral spring through a slot in the tube, *l*, indicates in ounces and pounds the tension required to press inwards the longer ends of the two arms, *i*, *j*.

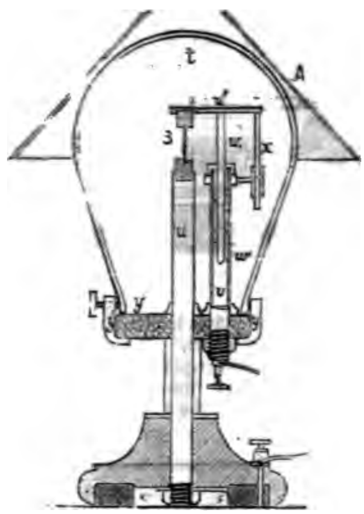


FIG. 2.

These arms are slotted out and placed over the top of the rheotome, which has been previously adjusted to the thickness of the gauge, *m*; then by screwing up the tension screw the force required to separate the studs, *f*, *g*, of the rheotome is indicated on the scale (marked on the tube, *l*) by the pin of the spiral spring before mentioned; the screw, o, at the shorter ends of the arms, *i* and *j*, prevents them from opening far enough to derange the said spiral spring. The apparatus by which the production of light is accomplished will be understood on reference to fig. 2, in which *t* is a closed vessel; *u* and u^1 are two holders, the holder, *u*, being stationary, and the holder, u^1, movable, being drawn down by gravitation, and making by preference a fluid contact in the iron tube, *v*. The rod, *w*, has a platinum stud screwed into the end at w^1, by which good contact is made with the mercury contained in the said tube, *v*. A light guide rod, *x*, moving in a suitable guide maintains the proper axes of the parts during the descent of the holder, u^1, in relation to *u*. The glass plate, *y*, sustains the rods and fittings, and forms a convenient base. A ring holder, y^1, with lugs and suitable screws fixes down the vessel to the glass base plate. The other details are of suitable size and character to facilitate the passage of currents through any carbon or other conducting matter at *s*. The oxygen is consumed quickly on passing a current through *s*, and after this the change in the condition of *s* is very small, but

slight changes may arise from the joint between the base plate and vessel not being quite perfect. A card or glass reflector, A, is placed over the apparatus.

275. "Electric semaphores for railway purposes." W. R. Lake. (A communication from abroad by Frances Robert Fountaine Brown, of the city of Montreal, Canada.) Dated Jan. 21. 6d. The object of this invention is to provide simple and effective mechanism for operating railway signals or semaphores, and it consists partly in a simple combination of gearing operated by a weight, and so arranged that the strength of the electro-magnet need not be in proportion to the said weight, and the invention further consists in a certain combination of mechanism hereinafter specified. Fig. 1 is a side elevation, and fig. 2 a cross section of the invention. A represents a box, which may be made of any material and design suitable for containing the lamp, B, and the mechanism hereinafter described; C is a metal frame for supporting the said mechanism; D is an electro-magnet suitably fastened to the frame, C, and properly connected by wires to a battery and circuit-breaker placed at a point from which the signal should be manipulated; E is a lever pivoted to the frame, C, and provided with an armature, *e*; *f* is a spring placed, as shown, to draw the armature, *e*, from contact with the electro-magnet whenever the current is broken; F is an arm attached to or forming part of the tumbling plate, G, and whose end rests upon the lever, E, when the armature, *e*, is not in contact with the electro-magnet, D. The dog, H, is pivoted on the same pin as the plate, G, but moves independently. One wing of this dog, H, fits into the ratchet wheel, I, and its other wing between two blocks or their equivalent on the tumbling-plate, G. The ratchet wheel, I, is keyed to the same spindle, I^1, as the spur pinion, J, which meshes into the spur wheel, *k*. This latter wheel, K, is keyed to the same spindle as the toothed wheel, L, around which hangs the chain, M, upon one end of which a suitable weight is hung. So long as the dog, H, is in gear with the ratchet-wheel, I, the full power and resistance produced by the weight on the end of the chain, M, is sustained by the said dog, and the gearing consequently remains stationary till the dog, H, is thrown clear of the ratchet, when of course the gearing revolves from the action of the said weight. The tumbling plate, G, is so balanced on its spindle by a weight, *g*, or otherwise, that unless supported it will fall in the direction indicated by the arrow, and being placed in the relation to the dog, H, described, strikes it sufficiently hard to knock it out of gear with the ratchet wheel, I, which latter immediately revolves till one of the pins, *k*, placed in its face comes in contact with the arm, *h*, on the tumbling plate, G, which action turns the plate, G, back into the position

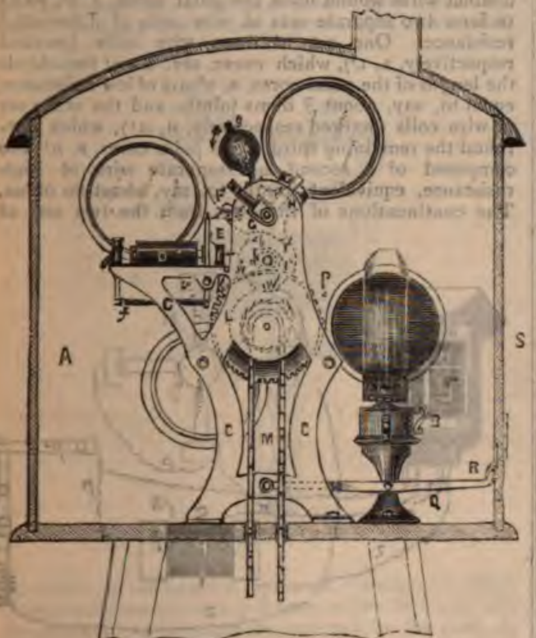


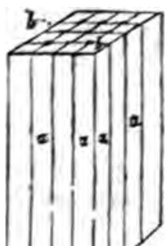
Fig. 1.

Fig. 2.

from which it has just fallen, carrying with it the dog, H, again into gear with I. The gearing just described is designed to operate the semaphore arm, O, which is keyed to the spindle, N, and geared, as shown, with the spindle, I^1, to which the ratchet wheel, I, is also geared; and as this has only four teeth at equal distance apart, each movement of the wheel, I, gives the semaphore an eighth of a turn, the gearing between the two spindles, N and I^1, being as two is to one. With the view of signalling at night, on to the spindle, I^1, are keyed the spiders, P, having four eyes, each of a different coloured glass. These eyes are so placed that at each stoppage of the wheel, I, one of them remains opposite to a properly protected hole in the box, A, immediately in front of the lamp, B, thus indicating by the colour of the glass the signal which the position of the semaphore arm, O, represents. As it sometimes happens that the arm will be opposite the hole above referred to, corresponding holes are made in the arm, O, so that the signal-light shall not at any time be obscured. To insure the weight being wound up, a lever, Q, is pivoted to the lamp-stand or any suitable place. One end of this lever is forked to allow the chain to pass freely through it, the other end

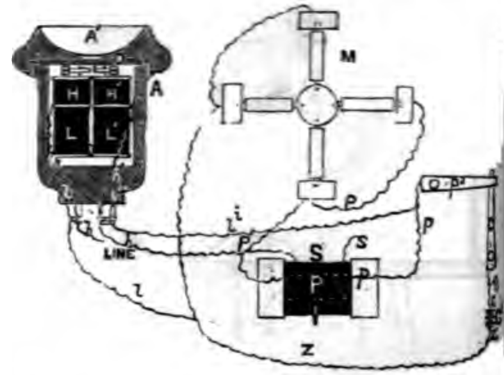
being pressed so as to engage with the catch, b, secured to the door, s, as shown. When the door, s, is closed the pivoted lever, l, securely locks it, as the forked end of the lever is heavier than the other. By placing a pin, p, through the chain, k, near the weight and having no other obstruction on the chain, k, the said chain will pass freely through the forked end, as before referred to, except when the pin, p, comes in contact with it, consequently the door remains locked, except when opened by the pin coming in contact with the lever. By this arrangement it is absolutely necessary to wind up the weight before the door, s, can be opened or the lamp is lighted.

[illegible]. "Manufacture of carbon and graphite," &c. Richard Wezelemann. Dated Jan. 22. 6d. Relates to the manufacture of carbon, and to the conversion of carbon into graphite for electric light carbons &c. In order to obtain such carbon or graphite sugar is carbonised either by heat or by the action of sulphuric acid or hydrochloric acid, or a mixture of sugar is made with essences, oils, resin, tar, or other substances, which when decomposed by heat leave a residuum of pure or nearly pure carbon. The carbon thus or otherwise obtained is then mixed with a solution of pure sugar, or with pure tar or oil, in such a manner that a homogeneous paste is obtained, the consistency of which must be regulated according to the form of the mould or to the length of the draw hole, hereinafter described, through which the paste is to be pressed. In the



manufacture of carbon pencils or electrodes, a moulding press is used constructed with a cylinder, in one end of which is inserted a block of metal or other suitable material. This block, which is shown by the figure, is either made of one piece or of several pieces, and is provided with draw holes, that is to say, holes through or into which this paste is to be forced to give it the required form. When dry the pencils are placed in a vessel containing a solution of sugar, tar, oil, or other suitable carbonaceous liquid. The said vessel has an air-tight cover provided with a cock, and a pipe connected with a vacuum pump. When a vacuum is produced in the said vessel the liquid fills up all the pores in the articles or pieces of carbon, which are now dried again, and when dry are placed into a mould of porcelain, fire clay, magnesia, or other suitable material, the two ends of the said articles or pieces being placed on metal bearings, or being otherwise connected with two conductors leading to the terminals of a generator of electricity, and the carbon is heated by the passage of the electric current to a white heat, whereby it is converted into graphite.

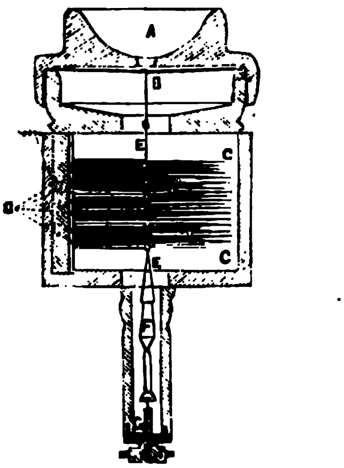
542. "Telephonic apparatus." Julius Sax. Dated Feb. 8. 6d. Has reference to the mode of constructing the electro-magnet of a telephone, and of connecting up the same, whereby a single battery is caused to serve both for the telephone and the microphone, such battery being augmented to any required strength. The figure represents a vertical section of an electro-magnetic receiving telephone with an improved construction of electro-magnet applied thereto to effect the required objects, the microphonic transmitter, induction coils, contacts, and usual appurtenances being shown in connection therewith. A is an electro-magnetic receiving telephone consisting of a casing containing a diaphragm, D, on one side of which is a mouth-piece, A', whilst on the opposite side of the diaphragm within the casing is an electro-magnet, the general arrangement of the parts being such as is commonly adopted in apparatus of this character. According to the invention, in lieu of using a single wire, the electro-magnet is constructed with two distinct wires wound upon the polar cores, B, B', so as to form two separate sets of wire coils of differential resistance. One set of these wire coils (marked respectively, L, L', which cover, say, about two-thirds the length of the polar cores, B, B', are of low resistance, equal to, say, about 8 ohms jointly, and the other set of wire coils (marked respectively, H, H'), which surround the remaining third of the polar cores, B, B', are composed of a second and separate wire of high resistance, equivalent jointly to, say, about 80 ohms. The continuations of the wires from the two sets of



coils are connected with a microphone, M, and induction coil, I, and a battery, C', in the following manner:— The carbon pole, C, of the battery, C', is connected to the spring, c, whilst the zinc pole, Z, is connected by means of the wire, z, to one side of the microphone, M, and also by a branch wire, l, to the one termination of the low resistance coil, L, upon the pole, B, of the electro-magnet of the receiving instrument. The other end of the wire forming the second portion of the low resistance coil, L', on pole, B', is attached to wire, l', in connection with another spring contact, p^2, and also with the branch wire, p, communicating with the primary wire and helix, P, of the induction coil, I; the other end of which primary wire is similarly connected to the other side of the microphonic transmitter, M, by the wire, p'. One end of the high resistance coil from, H, is connected to "line" by means of the wire, h, whilst its other extremity from, H', is connected by the wire, h', to the secondary wire and helix, S, of the induction coil, I, by which it communicates with "earth" by the wire, s. The resistance of the low resistance coils should be as nearly as possible equal to that of the primary wire of the induction coil and the microphone together. Under these conditions by the act of pressing the spring contacts, c or p^2, so as to unite their free extremities the

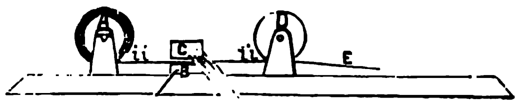
current from the battery, c^1, is caused to divide itself owing to the uniformity of resistance so as to flow partly through the microphone and partly through the differential resistance coil so as to charge or influence the electro-magnet of the receiving telephone, whereby one battery is made to serve for both instruments, the strength of the battery being augmented as required.

760. "Improvements in telephones." EDWARD W. ANDERSON. (A communication from John Goodman, of Louisville, in the United States.) Dated Feb. 23. 6d. Consists mainly in so arranging a magnet or series of magnets in combination with one or more resonators or diaphragms, and one or more conductors of electricity or helices, that when a current of electricity is passed through the conductor or conductors it will effect a change of position of the magnet or magnets, and as a result the diaphragm or diaphragms will be thrown into



vibration. In the figure, D represents the magnets, which in this instance are long and tongue-like in form, and are fastened at intervals by one end to the post, H, which is located at the side of the case near one end of the helix or helices, C. In this construction two flattened helices are employed, their long sides being parallel with each other, and one being a left hand, while the other is a right hand helix. These helices are designed to affect the magnets between them in the same manner that a single coil would if it surrounded them, and a single coil may therefore be employed with like effect. The magnets, D, extend between the coils, C, and parallel to the wires thereof, substantially in the manner shown in the drawings, and the extremities of the magnets opposite to the post, H, are left free to move. B indicates the resonator or diaphragm, made of thin metal, or other suitable material. A designates the ear-piece over the resonator, and E a cord, or other connection, extending from the resonator to the spring, F, which is designed to be connected to the case at the opposite end from the resonator. In its course the cord, E, is connected to the middle portions of the magnets, D, which are therefore in a manner strained or held in tension between two elastic devices, the resonator and the spring, F, which tend to hold said magnets parallel with the wires of the coils, C. This tension may be regulated by means of an adjustable screw, G, to which the spring, F, is connected.

1496. "Printing music by electricity." HERBERT YOUNG DICKINSON. Dated April 12. 4d. In this invention one, two, or more wheels are used, one of which (D in the figure) is acted upon by clockwork or a weight, or other suitable motor, so that it moves at a regular rate of speed. Chemically-prepared paper is passed round this wheel often enough to "nip" and so to continuously draw the roll of paper over the table, B, and under the box, C, from the roll or coil made on the wheel, A. Within the box, C, are a set of rulers which rule on the paper, *i*, *i*, as it passes over the printing table, B, five treble staff lines and five bass staff lines. The paper then passes under the pins in C, these being connected by wires with the keys of the instrument played upon. The return wire for the electric current for the stationary pins is attached to the table, B. The movable pins in C are acted upon by electro-magnets. The electric circuits are completed by the depression of the keys of the instrument played upon. When a note of the key-board of the musical instrument is depressed, the movable pin which works in connection with the said note is also depressed, and marks a fine line on the paper. This line will correspond



in length with the length of time during which the note is held down by the finger, so that the lines marked on the paper will vary according to the length of time the notes are held down, the position on the paper of the lines so marked will correspond with the position of the notes struck on the key-board. The pins are also so placed that if a note would fall inconveniently high or low, if printed in its proper position, the said note will be printed an octave lower or higher, as the case may require. The depression of these notes will therefore close two circuits, one for printing the note (which is the same one as used for printing the note in a different octave), and one which is common for indicating the octave higher or lower. After the paper passes away from the machine at E, the various notes printed as above described can be valued, and if necessary can be written out or printed in the ordinary musical notation. If more convenient, the paper could be collected round the wheel, D, and uncoiled afterwards. There may be a catch to the wheel, D, so that the machine may be started or stopped at will, or the motive power may be thrown out of gear by any ordinary mechanism for that purpose.

1726. "Electrical call for telegraphic and telephonic purposes." W. R. LAKE. (A communication from abroad by David Hall Rice and Jacob B. Currier, both of Lowell, Massachusetts, United States of America.) Dated April 20. 8d. Relates chiefly to improvements in electric calling and alarm devices to be placed upon telegraphic or telephonic circuits or lines to call and sound an alarm at any one of a number of stations on such circuit without calling and alarming any other station upon the said circuit. The invention comprises the employment upon such telegraphic or telephonic lines, for the purpose of ringing alarms or calls, of vibrating springs or reeds, which are graduated so as to vibrate at given normal rates of oscillation, and an undulatory or broken electric current synchronous with the reed or spring to be actuated, each of the said reeds on a circuit being different from every other, and each being placed at a different station on the said circuit, and operating directly or intermediately upon the bell or alarm mechanism. The transmitting device consists of a contact reed, whose length can be increased

or shortened to the length necessary to give the number of vibratory currents corresponding to the rate of vibration of any particular alarm reed.

2217. "Electrical cables or conductors." W. R. LAKE. (A communication from abroad by Patrick B. Delany, of New York.) Dated May 20. 6d. The object of this invention is to provide a multiple wire electric telegraphic or other cable having great flexibility and strength, and in which the several conductors will be effectively insulated from each other and protected from contact with outside objects, the said cable being adapted for use either in the air or underground. Fig. 1 represents in elevation a portion of aërial or overground telegraphic cable, and fig. 2 is a side view partly in section of a portion of an underground cable constructed according to this invention. A indicates the insulating buttons which support and keep separated the wires. These buttons may be made of glass, porcelain, or any other suitable insulating material, and

FIG. 1.

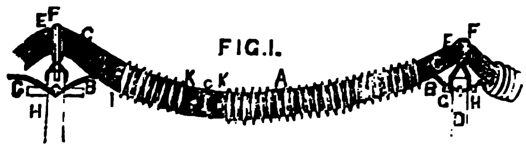
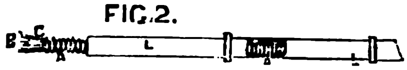


FIG. 2.



of any desired diameter, and each button has a central hole, *a*, for the passage of the supporting and strengthening rope or cable, B. Between the central hole and the periphery of the said buttons, and at a proper distance from such periphery and from each other, are formed the small apertures, a^1, for the passage of the conducting wires, C. The outer apertures for the passage of the wires should be at such a distance from the peripheries of the buttons that should the buttons come in contact with the ground, a wall, or other object, the wires will be held out of contact with such object. When the cable is laid underground it is inclosed in an iron pipe as shown by fig. 2.

2398. "Telephones." R. M. LOCKWOOD and W. V. O. LOCKWOOD. Dated May 31. 6d. Relates to the telephone referred to on page 193 of the TELEGRAPHIC JOURNAL for May 15th, 1881.

City Notes.

Old Broad Street, September 28th, 1881.

DIRECT SPANISH TELEGRAPH COMPANY, LIMITED.—The report of the directors for the half-year ending 30th June, 1881, to be presented at the general meeting of shareholders to be held on Friday, September 30th, 1881, states that the accounts for the half-year ending 30th June, 1881, show a balance to the credit of profit and loss of £7,245 1s. 5d. The result of the half-year's working may be considered satisfactory, the receipts being in excess of those for any previous half-year, except that ending 31st December, 1875, when exceptional circumstances caused a large increase of traffic. The Company's cables and land-lines continue to work perfectly, the high electrical condition of the submarine cables showing no variation. The advantages anticipated from the removal of the cable station from the Lizard to Falmouth have been fully realised. The entire cost of the construction of the land line between Falmouth and the Lizard necessary to effect this removal is shown in the accounts, and is slightly in excess of the estimate of £2,500. The payment of the dividend on the preference shares will absorb £2,921 10s. od. of the balance of profit and loss, leaving £4,323 11s. 5d., from which the directors recommend that a dividend be declared of 3s. per share on the ordinary shares for the half-year, free of income tax, being at the rate of 3¾ per cent. per annum, and that the sum of £2,302 1s. 4d. be added to the reserve, raising that fund to £5,500, and leaving £81 17s. 1d. to be carried forward to the next half-year.

AMERICAN CABLE COMPANY.—We notified in our last issue, that this Company would commence business on the 15th September; it was not, however, until the 17th that messages were accepted, as the New York offices were incomplete. After one day's cabling, it was reported that a fault had shown itself in deep water; that a fault has occurred is quite true, but we think not in deep water. The *Faraday* has yet to take out the last portion of the second cable for this company.

THE Eastern Extension Telegraph Company announce that their accounts to 30th June last (subject to audit) show a balance of profit of £94,755 for the half-year, allowing, with interim dividends already paid, of a total payment of 3 per cent. for the half-year.

AT a meeting of the directors of the Globe Telegraph and Trust Company (Limited) it was resolved to declare a dividend of 3s. per share on the preference shares, being at the rate of 6 per cent. per annum, and 2s. on the ordinary shares, or at the rate of 4 per cent. per annum, for the quarter ending October 18 next.

The following are the final quotations of stocks and shares:—Anglo-American, Limited, 53-53½; Ditto, Preferred, 82½-83½; Ditto, Deferred, 24-24½; Brazilian Submarine, Limited, 10¾-11; Brush Light, ——; Electric Light, ⅜-½; Consolidated Telephone Construction, ¾-1 A; Cuba, Limited, 9½-10; Cuba, Limited, 10 per cent. Preference, 16½-17; Direct Spanish, Limited, 5-5½; Direct Spanish, 10 per cent. Preference, 16½-17; Direct United States Cable, Limited, 1877, 10⅜-10⅝; Debentures, 1884, 102-104; Eastern Limited, 10⅜-10⅝; Eastern 6 per cent. Preference, 13-13¼; Eastern, 6 per cent. Debentures, repayable October, 1883, 103-106; Eastern 5 per cent. Debentures, repayable August, 1887, 102-105; Eastern, 5 per cent., repayable Aug., 1899, 105-108; Eastern Extension, Australasian and China, Limited, 10⅞-11⅛; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 108-111; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 104-107; Ditto, registered, repayable 1900, 104-107; Ditto, 5 per cent. Debenture, 1890, 103-106; Eastern and South African, Limited, 5 per cent. Mortgage Debentures, redeemable 1900, 103-106; Ditto, ditto, to bearer, 104-107; German Union Telegraph and Trust, 10¼-10¾; Globe Telegraph and Trust, Limited, 6½-6¾; Globe, 6 per cent. Preference, 12½-12¾; Great Northern, 12¼-12¾; 5 per cent. Debentures, 103-106; India Rubber Company, 24-25; Ditto, 6 per cent. Debenture, 104-108; Indo-European, Limited, 28-29; London Platino-Brazilian, Limited, 5½-6; Mediterranean Extension, Limited, 2½-3; Mediterranean Extension, 8 per cent. Preference, 9½-9¾; Oriental Telephone, ¼-½; Reuter's Limited, 11½-12½; Submarine, 280-290; Submarine Scrip, 2¾-3; Submarine Cables Trust, 99-103; United Telephone, ——; West Coast of America, Limited, 4½-5½; West India and Panama, Limited, 1⅛-1⅜; Ditto, 6 per cent. First Preference, 7¼-7¾; Ditto, ditto, Second Preference, 6¼-6¾; Western and Brazilian, Limited, 7⅜-7⅝; Ditto, 6 per cent. Debentures "A," 110-115; Ditto, ditto, ditto, "B," 101-105; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 125-130; Ditto, 6 per cent. Sterling Bonds, 104-107; Telegraph Construction and Maintenance, Limited, 25½-26½; Ditto, 6 per cent. Bonds, 104-108; Ditto, Second Bonus Trust Certificates, 1½-1¾.

THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. IX.—No. 209.

THE PARIS ELECTRICAL EXHIBITION.

THE BRITISH SECTION.

ELLIOTT BROTHERS.

(Continued from page 374.)

"FIRING RHEOSTAT." This instrument, which is of the Government pattern, is used in two ways, viz., with or without the bridge; in the latter case it forms an ordinary set of resistance coils, and in the former, a bridge with 10 ohms in the "ratio" branches. When the apparatus is used as a firing rheostat, a platinum wire of a definite thickness is clamped between two pillars which are exactly $\frac{1}{4}''$ apart; the current which is to be used for firing fuzes is sent through the resistance coils and the platinum wire first, and then the resistances are varied until the platinum becomes heated white hot.

"OIL-VESSEL GALVANOMETER" (wrongly called so, because generally distilled water is used for damping the oscillations of the needle). This instrument is also a Government pattern; the coils contain fine and stout wire, one having 2,000 ohms, the other $\frac{1}{2}$ ohm resistance. The mirror has a diameter of $\frac{3}{4}$ inch, and the magnet a similar length. The two are mounted on a platinum stem, which has a loop at its lower end for holding a platinum vane, which latter is simply hooked on. A switch at the left of the instrument facilitates the changing from high to low resistances and *vice versâ*. A shunt box is also provided for the high resistance, and is easily connected.

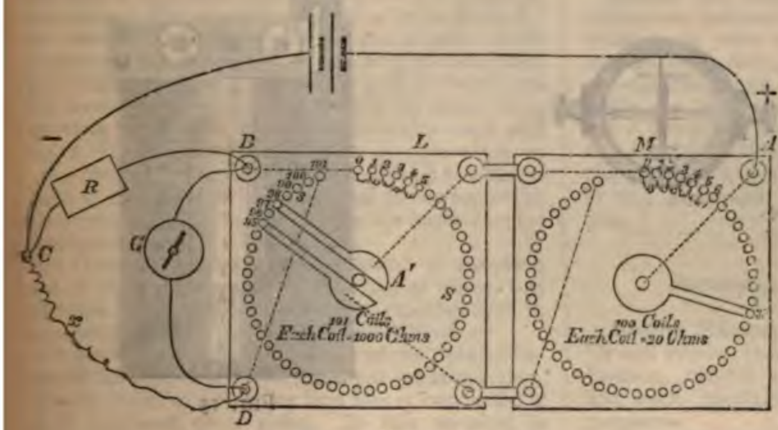


FIG. 10.

FIG. 11.

11a.

FIG. 13.

"SLIDING COILS." (Figs. 10 and 11.) The portion, L, of this apparatus (fig. 10) has two revolving arms fixed parallel to each other, and embracing two coils. The current from one pole of the battery enters this double arm at A^1, passes along it, and is

divided in the two branches, S and s. If the arm is moved one division to the right, S is increased, and s is decreased by 1,000. For finer adjustment the current is divided in the coils, M. As shown by fig. 10, the resistances in the two "ratio" arms of the bridge are S = 95680, and s = 4320.

"DIFFERENTIAL REFLECTING TRIPOD GALVANOMETER, LOW RESISTANCE." This instrument differs from the others by having, in place of copper wire, a silk-covered copper *band*. Each coil is mounted on a dovetail, moved by a screw from the back. The copper band has a decided advantage over the copper wire, especially for low resistance, as it brings the convolutions much nearer the needle.

"REFLECTING TRIPOD GALVANOMETER, HIGH

"ROUND BRASS CASE ASTATIC GALVANOME GLASS CYLINDER, AND SQUARE CASE GALV METER." These are all three essentially the s the difference being only in the outer cases. delicately-suspended light astatic needle, wit ⅜" mirror, is inclosed by four coils of copper of which two act on the upper and the other tw the lower of the astatic needle. The needle 10 light magnets. The two upper and the two lo coils of wire are connected with four terminals enable the experimenter to join the coils in se or in multiple arc.

"SIMPLE MAGNETOMETER," is constructed observe the deflections of a delicately-suspen mirror and magnet, either caused by terrest magnetism or other influences.

FIG. 14.

FIG. 15.

FIG. 16.

FIG. 12.

RESISTANCE." (Fig. 11a.) This is a very portable and a very sensitive instrument, it has a very light astatic needle.

"REFLECTING WOOD CASE GALVANOMETER," differs from the previously described instrument in two points; it has for cheapness sake a mahogany case and a long silk suspension inside the tube on which the directing magnet moves up and down. The *needle is astatic*, but has no aluminium vane. A *very good instrument*.

"POST-OFFICE SET OF RESISTANCE COILS" (fig. 12) with switch at the side, the well-known type wi resistances from 1 to 4,000 ohms, and 10, 100, a 1,000 ohms in the bridge ratio. The switch or com mutator at the side reverses the "line" a "earth" connections, so that either positive negative currents can be sent to line, whilst the deflection of the galvanometer needle due to, a too much resistance being in the adjustable arm the bridge, is always in the same direction.

"SMALL REFLECTING GALVANOMETER." The needle in this instrument is not astatic, but the influence of earth's magnetism is neutralised by the directing magnet. The needle is suspended in a brass tube. The coil consists of stout wire.

"BROWN'S DETECTOR" (fig. 13) is an ordinary vertical galvanometer; but the coil has three sections, of 2, 10, and 1,000 ohms respectively.

"PORTABLE ASTATIC GALVANOMETER." The chief feature of this galvanometer (which is shown by fig. 14) is its portability. The resistance is 1,000 ohms, and the astatic needle is pivotted in jewelled holes to reduce friction. The galvanometer packs into a leather case with a small bar-magnet, which prevents the needle from too violent oscillations. The same magnet is used to increase or decrease the sensitiveness of the instrument.

"WIRE GAUGE ON BOX," made of German silver, reading to $\frac{1}{1000}$ inch without the use of a magnifying glass. The screw has a pitch of 50 to the inch; to one end of this screw is fixed a tube which represents the drum, divided to 20; the elongated part through which the screw passes has divisions for every turn of the screw, and the drum tube, moving over these divisions, subdivides each part ($\frac{1}{50}$th inch) into twenty, which is equivalent to $\frac{1}{1000}$ inch. This gauge can measure up to a thickness of half-an-inch. When fitted to the top of the box (into which it packs) it leaves the hands free for manipulation.

"DUBOIS RAYMOND'S RHEOCHORD" is simply a set of resistances made up of platinum wires, one of them being variable by a slide moving over it. Generally used in the physiological laboratory.

"SAUNDER'S LIGHTNING DISCHARGER," placed between land line and cable, is of a novel construction. The terminal to which the land line is connected is well insulated on a pillar. To this terminal is fastened a platinum wire $\frac{25}{10000}$ inch thick, which passes through a long tube; four pointed screws are placed at each end of the tube, the points being very close to the platinum wire. The other end of the wire is fastened to a spring, the spring proceeding from the well-insulated terminal, connected with the cable. Tube screws and a terminal with a platinum pin, just in line with the wire and behind the spring, are all connected to earth. The lightning, destroying the fine wire, lets the spring press against the platinum pin at its back, and so puts the cable to earth.

"HALF-INCH ENGLISH AND FRENCH WIRE GAUGE, WITH TAYLOR'S RATCHET." Similar to the one described above. To read in French measure, a second drum-tube, which surrounds the drum, is fixed to the screw, and slides longitudinally over the latter. The outer drum is divided, so as to subdivide to fractions of a millimetre. The inner drum divides the inch into thousandths. When the French measure is required, the outer drum is pushed over the division of the inner tube; a pin prevents it being pushed too far. The ratchet arrangement prevents too much pressure being put on the gauge.

"MILNER'S FLAT GAUGE." (Fig. 15.) This gauge is entirely different from the others in every respect, and it has the great advantage that in gauging only one hand is required, whilst the others require both hands. The jaws move *parallel by a parallel* motion; one jaw has an elongation, moving over a number of parallel lines $\frac{1}{10}$ inch apart, running in the same direction as the jaws. The elongation of the movable jaw is bevelled and divided into 20 parts. The zero and the twenty, cut two adjacent parallel lines on the opposite ends when the jaws are measuring $\frac{1}{10}$, $\frac{2}{10}$, &c. The 20 divisions on the bevel subdivide the tenths to fiftieths.

In Milner's circular gauge, on the same principle, but of a simpler and different construction, the movable jaw slides in a tube.

Fig. 16 shows a "SHORT CIRCUIT PLUG," which is of peculiar construction, being specially designed to give a very perfect contact; this is effected by means of a cap which fits over a split tube the two halves of which are respectively connected to the two terminal screws. An ordinary plug in the centre of the cap also makes a contact in the usual way.

Besides the foregoing, a large quantity of miscellaneous instruments are exhibited which it is needless to refer to, as they are of well-known construction, though we may remark that their general design and finish are excellent.

[In our last issue, on page 374, we stated that the "Quadrant electrometer" (fig. 7) gives ·100 divisions deflection with one Daniell cell, whilst the Thomson's gives 300; the figures 100 and 300 in this paragraph should be reversed.—ED. *Tel. Jour.*]

RANSOMES, HEAD AND JEFFERIES.

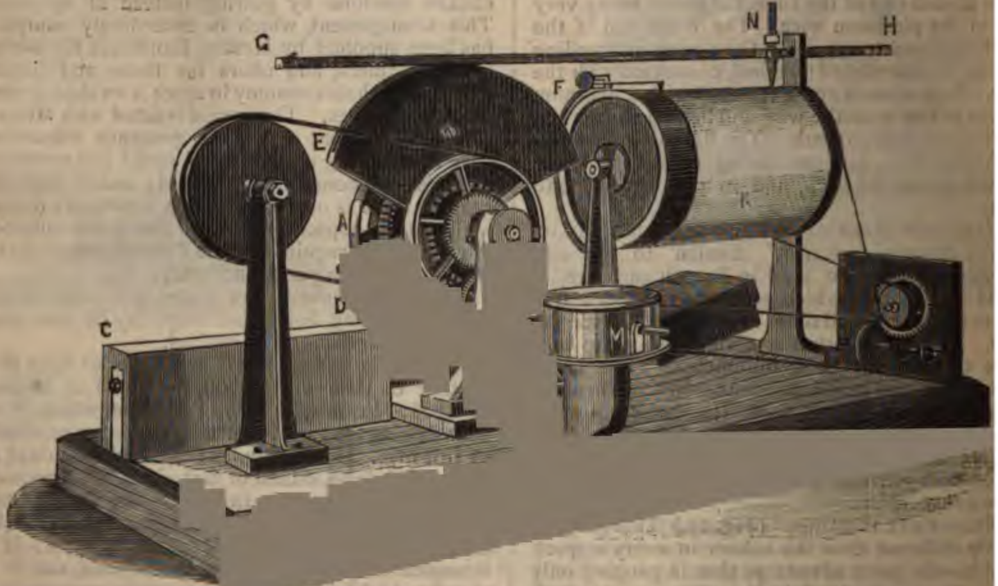
Messrs. Ransomes, Head and Jefferies, of the Orwell Works, Ipswich, and 9, Gracechurch Street, London, exhibit a vertical steam engine, which has been specially designed for electric light purposes.

The engine (as will be seen from the engraving on p. 396) has a spur fly-wheel for driving the dynamo-electric machine by gearing instead of by strap. This arrangement, which is exceedingly compact, has been supplied by Messrs. Ransomes for use on board steamers, and offers for these and similar situations, where economy in space is an object, very great advantages. The engine is fitted with Messrs. Ransomes' patent automatic governor expansion gear for securing uniformity of speed and economy of steam, and consequently of fuel; and as with the gearing there is no "slip," which sometimes occurs with a strap, especially if at all damp, the number of revolutions required by the dynamo machine can be obtained with perfect accuracy.

The engine, shown on page 396, takes steam from an existing boiler, but they may be had with the boiler complete, if so desired.

Messrs. Ransomes, Head and Jefferies have also another of their engines on the stand of Messrs. L. Clark, Muirhead & Co., of London, which is at work driving the various electric machinery exhibited by this firm. This engine is of ten-horse nominal, of the portable type, similar to that which has been used continuously for nearly three years on the Thames Embankment, and which was illustrated in the number of the Journal for March 15th, 1879. It is mounted on pedestals instead of wheels, and it is also fitted with the patent automatic governor expansion gear already referred to.


RANSOMES HEAD & JEFFERIES
ENGINEERS
IPSWICH ENGLAND
4089


G
N
H
F
E
A
D
C
M

FREDERICK J. SMITH.

F. J. SMITH, of Taunton, exhibits a model of an nious form of dynamometer for showing at instant the force transmitted in working any hine.

he leading feature of the design of the machine ich is shown on page 396) is that the spring :h is extended by the force transmitted is in vay affected by centrifugal action.

n a shaft carried by two supports are two pulleys, . One is driven by a prime mover, the other es the machine to be tested; to each pulley a l wheel is fixed; these bevil wheels are in gear with rd bevil wheel between them, the axis of which el is at right angles to the axes of the former. frame which carries the central wheel is capable ny angular displacement, the wheels, of course, g in gear in every position. A spiral spring in the , C, D, acts at a tangent to the sector-shaped frame :h carries the central wheel, so that any difnce of pressure between the teeth of the wheels, ects the arc-shaped piece, E, and moves a light G, H, which records (by means of a glass tracingt, N) a curve on the drum, K; the area of this e, as in other recording instruments when rpreted, shows the number of foot pounds smitted. A lever actuated by an electro-magnet rolled by a pendulum beating seconds, records neans of the pointer, F, the seconds during which portion of the curve was traced; this is only when it is required to make a close approxion; without the diagram the deflection is read pointer, and the revolutions per minute taken he counter, M. The machine has recently been so modified in construction, that it is made on one vertical casting, the recording parts being at the top of the wheels.

A small form of the dynamometer has been used in experiments in heat and electricity, and also in connection with a whirling table.

WM. M. FOXCROFT.

This exhibit, which is the only one of the kind in the whole Exhibition, is by that enterprising cabinet work manufacturer Mr. W. M. Foxcroft, of 54, Compton Street, Clerkenwell, London, E.C. It consists of a large number of wooden cases for telegraph apparatus of every description. These cases are very fine specimens of work as regards design and finish, and reflect great credit on the manufacturer. Fig. 1 is a new design for a "Blake's" transmitter and bell case combined, hitherto this has necessitated two separate cases, one for the bell and one for the transmitter, but in Mr. Foxcroft's case the two are combined, the transmitters being in the upper portion, and the work for the bell being under the desk; the bell is placed under the latter with the push just above. Fig. 2 is simply a sample of a bell case for domestic purposes, as shown by Mr. Foxcroft in various woods. Fig. 3 shows a specimen of the well-known "Gower Bell" telephone case. These cases are shown in woods to match the fittings of any mansion or house of business, those of teak are adopted by Her Majesty's Government, for business purposes and for mansions we have satinwood and black, onyx and black,

FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

FIG. 5.

FIG. 6.

black and gold, brown, oak, walnut and other fancy woods suitable for the most artistically fitted mansions. Fig. 4 represents a sample of the speaking instrument case (single needle) in use upon the Midland Railway. It is similar to the General Post-office pattern. Fig. 5 is a view of a case for "Syke's" block instrument (*see* "Telegraphic Journal," June 15th, 1880). The wear and tear upon the case being great the simplicity of the design has been necessitated by the strength required. Fig. 6 shows the ordinary block instrument case (single needle) so extensively used by the various railways throughout the world.

design. The "CROSSLEY TRANSMITTER," described in the "Telegraphic Journal," vol. vii., p. 144, is exhibited in various forms, three of which are illustrated in figs. 1, 2, and 3. Fig. 4 represents the early and well-known instrument, which is exhibited at the exhibition, beautifully made up with glass sides, all the working parts being nickeled. Fig. 2 represents a smaller transmitter, combined with a "magneto generator and call-bell," such as are now almost exclusively used in the exchanges both in this country and in America. Fig. 1 illustrates an upright Crossley Transmitter, combined with the same style of apparatus and

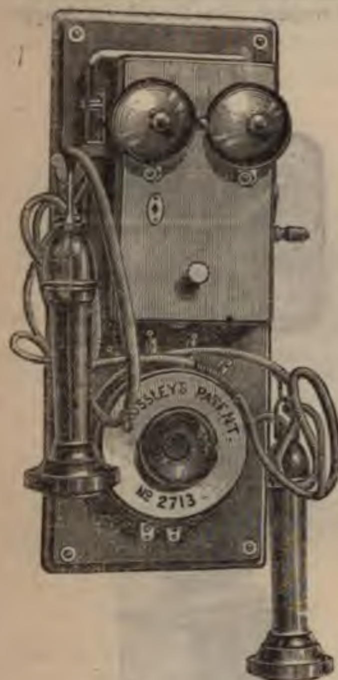


FIG. 1.

FIG. 3

FIG. 2.

FIG. 4.

BLAKEY, EMMOTT & CO.

The exhibits of Messrs. Blakey, Emmott & Co., of the Northern Telegraph Works, Halifax, are *very excellent* samples of good workmanship and

double telephones. The Crossley Transmitter is also exhibited working in various parts of the exhibition, being connected with the telephone exchanges of the Society General of Telephones and other places. We understand that a company

s been formed to work the Crossley patents in dia, Australia, New Zealand, &c. Fig. 3 is a nple magneto call-bell for use with this system.

The "WARBURTON AND CROSSLEY BELL INSTRU-ENT" (described in the "Telegraphic Journal" for arch 15th, 1880), is shown in working order.

Mr. "KEMPE'S SPEED INDICATOR," which is also hibited, excites much interest, being connected to ie of the engines. This instrument has been scribed in the "Telegraphic Journal" for May 15th, 80.

A very good "single needle block instrument," gether with "electric bells," "relays," and a late electrical machine," are also amongst the ex-bits of this firm.

THE EXPERIMENTS OF M. BJERKNES.

By FRANK GERALDY.

a rule, words must be distrusted: in the first place often happens that their meaning is ill-defined or it they are not understood by every one in exactly same manner, which involves the most unpleasant stakes. But even in the case when they are precise d are received everywhere in one sole acceptation re remains still a danger, that of passing from the rd to the idea and of being led to believe that be-se there is a word there must be some real being signated by that word.

Let us take, *e.g.*, the word electricity; if we under-

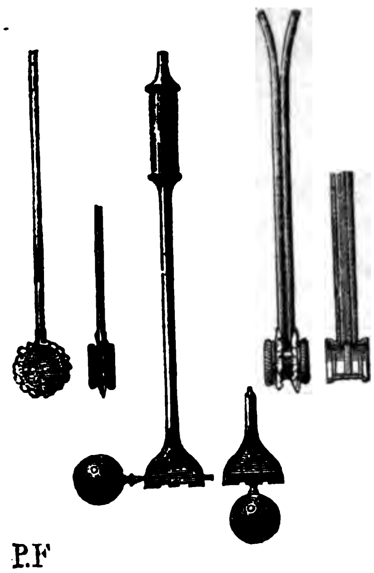


FIG. 1.

and by this term the common law which connects gether a certain category of phenomena it expresses clear and useful idea; but we have no right to con-ide *a priori* from its existence that there exists a stinct agent called electricity which is the efficient use of these phenomena. We ought, according to philosophic rule, never to admit beings without ab-lute necessity. The progress of science has always consisted in gradually eliminating these provisional conceptions and in reducing the number of causes. This is visible without even going back to the ages of ignorance, when every new phenomenon brought with it the conception of a special being by which it was caused and directed. In the last ages we had *spirits*, such as volatile liquids, gases, or even the theoretical conception like phlogiston. At the end of the last century and at the beginning of the present, ideas had already become more sensible. The notion of "fluid" was admitted, a mysterious and somewhat vague category, but still slightly definite. Under this head were arranged the unknown and intangible causes of thermic, luminous and electric phenomena, &c. By degrees the "fluid" vanished and we arrive, or rather we arrived a little time ago, at the notion of "forces"—a precise idea, mathematically comprehensible, but still mysterious in its essence.

Now this conception is gradually disappearing, leaving us merely the elementary ideas of matter and motion—ideas not perhaps much clearer, philosophically speaking, than the others, particularly that of matter considered in itself, but which are at any rate necessary, since all the others pre-suppose them.

Among those notions which study and time have reduced into other and simpler notions, that of electricity should take its place; it presents itself more and more as one of the particular cases of the general movements of matter. This will be the eternal honour of Fresnel that he introduced into science and established mathematically the theory of undulations (suggested, indeed, before him), giving thus the first example of the notion of motion substituted for that of force. Since the principle of the conservation of energy has assumed the prominent position which it now occupies, and since we have seen the continual transformation of one series of phenomena into another the mind is immediately drawn, on witnessing a novel fact, towards an explanation of this kind. Still it is certain that such hypotheses are not easily justified. The motions which we call at present molecular, and which we cannot help assuming as being the source of almost all action, cannot be grasped in themselves, and can be demonstrated only by the coincidence of a great number of consequences. There is, however, another method for rendering them probable, the use of analogy. If we are able to reproduce the effects of electricity by means of vibrations which can be directly demonstrated, there is then reason to admit that electricity is nothing but a system of vibrations, differing merely by special qualities, such as dimension, direction, rapidity, &c.

Such is the result of the very curious experiments due to M. Bjerknes. They form a body of striking results, perfectly concordant and presenting very distinct analogies with electricity as we are about to see.

They depend upon the presence of bodies set in vibration in a liquid. The vibrations which M. Bjerknes produces are of two kinds, pulsations and oscillations. The pulsations are obtained by the aid of small drums, closed by flexible sides, such as are represented on the left of fig. 1. A small cylinder or pump-barrel is connected by means of a tube with this closed chamber, where the rapid movement of a piston alternately aspirates and drives back the air. The two sides are successively pushed outwards and drawn towards the centre. In an apparatus of this kind, the two sides repel the liquid at the same time and attract it at the same time. Their movements are in the same phase, and if it is wished that the one should repel whilst the other attracts, two drums must be set back to back, separated by a rigid partition, must be connected

with two separate pump-barrels, the movements of which are combined in such a manner that one sucks up whilst the other ejects. A system of this kind is to be seen on the right of fig. 1.

The vibrations are obtained by the aid of small metallic spheres fixed in tubular supports of movable levers, to which are communicated the movements of the compression and expansion of the air in the barrel of the pump. They oscillate in a plane, the direction of which, perhaps, varies according to the arrangement of the sphere, as is seen in two apparatus of this kind represented in fig. 1. Fig. 2 gives an idea of the total arrangement.

The two pistons of the air-pumps are joined to connecting rods, so that their phases may be regulated at pleasure, either in coincidence or in opposition. The whole is driven by means of a wheel or belt which renders it possible to obtain rapid vibrations. Caout-

in magnets, like poles repel and unlike poles each other.

It must be remarked that the surface of the presented is indifferent, since both are in the phase; the drum behaves, therefore, like an i magnetic pole, or rather like a magnet having middle a consequent pole. In order to have tw a double drum is necessary. The experiment i complicated; two pump-barrels are needed w alternately for this drum alone, and one or two for the moving drum. The effects are more shown with the vibrating spheres, as will b directly.

This form has the advantage that the osci body presents at once both phases; relatively liquid one of its sides advances while the other re thus we may, with a vibrating sphere presented moving drum, obtain either attraction or rep

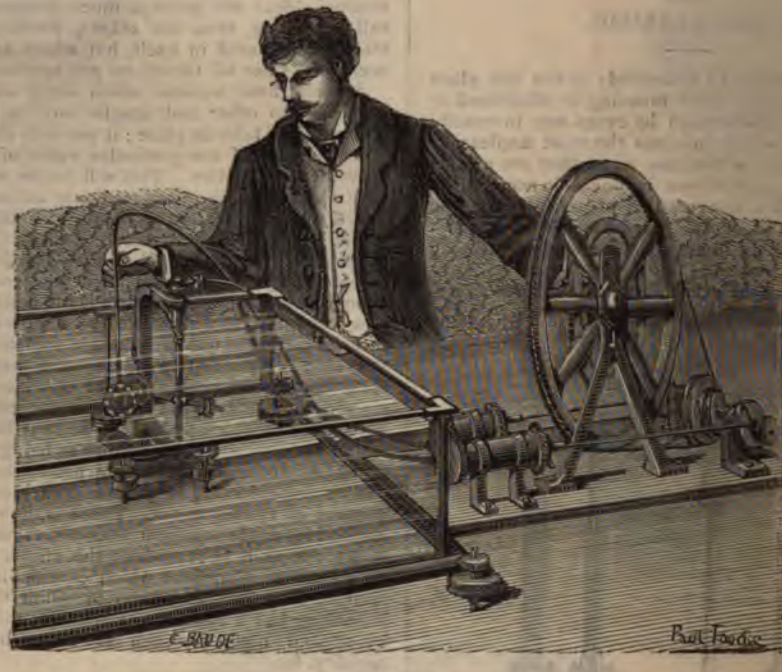


FIG. 2.

chouc tubes conduct air into the apparatus without interfering with its movements.

We can now enter into the details of the experiments. The first is represented in fig. 2. In a tank of water there is placed a little structure carrying a drum fixed upon an axle and capable of turning. It is, moreover in communication with one of the air cylinders. The operator holds in his hand a second drum, placed in connection with the other cylinder. The pistons are so adjusted that they move simultaneously; then the sides of the drums expand and contract simultaneously. If the drums are brought near each other, there appears a very marked attraction, the revolving drum following the other. If we adjust the connections so that the pistons work alternately, there is repulsion, so the movable drum recedes from the other. The effect is therefore analogous to that of *two magnets, with this difference merely*, that the like *phases attract* and the unlike repel each other, whilst

according as the approaching side is in a phase cordant or discordant with the side of the drum.

We may make a series of interesting experim with the arrangement shown in fig. 3.

The two spheres are put in simultaneous vibra and the support is free to revolve on its axis. effect is analogous to that which is produced by short magnets carried by one and the same revol support. On presenting the vibrating sphere to ends the entire system may be repelled or attrac according to its phase and the point where it is sented. If we substitute for the transverse suppo single sphere, as shown by the dotted line in fig. obtain the analogue of a short magnet supported a pivot, like a small compass. This sphere follows pole of a vibrating sphere presented to it, as woul the pole of a magnet with this reservation that i magnet like poles repel each other, whilst with t oscillating bodies, like phases attract each other.

In all the foregoing experiments the bodies brought near each other, are both in motion and the phenomena, resemble those of permanent magnetism. We may also reproduce those which arise from magnetic induction. For this purpose we employ small balls of different materials suspended to floats, as shown in fig. 4 (*a*, *b*, *c*). Let us take, *e.g.*, the body *b*, which is a small sphere of

FIG. 3.

metal and present to it, either a drum excited by pulsations, or an oscillating sphere, and it will be attracted, thus representing the action of a magnet upon a piece of soft iron. A curious experiment shows the transition between this new series and the former. If we present

FIG. 4.

to each other two drums in opposite phases, but arranged in such a manner that one of them vibrates much more strongly than the other, on approximating them cautiously, we find that the drum, which has the greater movement, at last exerts upon the author the same action as if the latter were motionless. The effect is analogous to that which takes place between a strong and a weak magnet if their like poles are presented to each other.

On continuing these trials we arrive at a very important point. Instead of the body, *b* (fig. 4), let us take *c*. As the figure shows this is a body lighter than water, and kept in that liquid by a weight. If we present to it the vibrating body it will be repelled, and we obtain the results known under the name of diamagnetism. This experiment brings the influence of

FIG. 5.

mediums into prominence. It is known that Faraday ascribed these effects to the action of the air; he considered that magnetic movements always resulted from a difference between the attraction exerted by the mag-

FIG. 6.

net upon the body experimented upon, and the attraction exerted upon the air. If the body is more sensitive than the air there is direct magnetism; if less sensitive there is diamagnetism. The water between the bodies in the experiments of Bjerknes plays the same part; by its vibration it transmits the movements and determines

the phases of the suspended body. If the body is heavier than water its movement is smaller than that of the liquid, and consequently relatively to the vibrating body it is in the same phase; if it is lighter the contrary is the case and the phases are discordant. These effects can be easily verified by means of the little apparatus, fig. 5, which bears two bars, the one lighter and

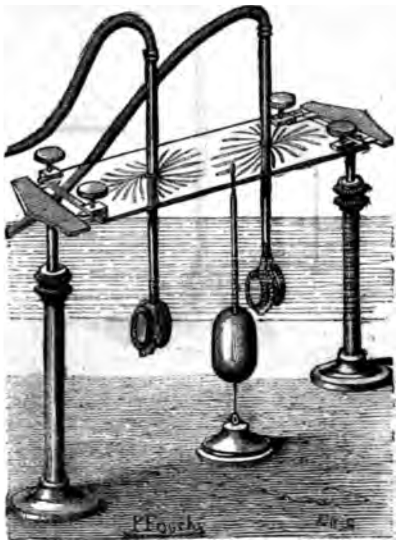


FIG. 7.

the other heavier than water. On approximating the vibrating body to them the one presents its end and takes an axial direction, whilst the other places itself transversely and takes an equatorial direction. These experiments may be varied in sundry manners, upon which it is needless to enlarge as they may be seen at the Exhibition.

We obtain very curious effects also with the arrangement, fig. 6. Between the two drums we introduce a body supported by a float, as is represented in fig. 4 *a*. We may then arrive at different results according to the combinations adopted. Let us suppose that the phases are similar, and that the interposed body is heavier than water; it is then repelled as far as the circumference of the drums, where it stops. If the phases are different the body moves in the opposite direction and stops in the centre.

If the body is lighter than water the effects are naturally modified. If placed between two similar phases it is attracted in a certain radius and repelled if placed at a greater distance. If the phases are opposite it is always repelled. We may easily satisfy ourselves that these effects are analogous to those produced upon bodies placed between two poles of large and powerful magnets. We find here in particular a reproduction of some of the experiments of Faraday. It is needless to repeat that the analogies are always inverted.

M. Bjerknes has carried the examination of these phenomena further and has studied experimentally the action taking place within the liquid. For this purpose he makes use of the arrangement represented in fig. 7. Alongside the vibrating body is placed a light body mounted upon a very flexible spring. It takes the movement of that portion of the liquid where it is placed and by means of a small pencil he writes the direction of the movement upon a plate presented above. On placing this indicator in different directions the whole liquid may be explored. We obtain thus figures quite similar to magnetic figures.

All the cases may be reproduced, the vibrating sphere giving the curves of a magnet with its two poles. We may even show the mutual action of two magnets; the figures are remarkably distinct: if anything more clear than those obtained with actual magnets.

It must not be thought that these interesting facts are of a tentative nature, the result of a happy experiment. On the contrary, they have been foreseen and determined. M. Bjerknes is above all things a mathematician; the study of the vibratory movement of a body or a system of bodies in any medium has led him to the results which he has since realised experimentally.

As a continuation of the solutions produced by M. Lejeune Dirichlet, M. Bjerknes undertook this investigation about 1865, and found that from these movements there must result the production of regular mechanical actions. He calculated the direction of these actions and about 1875 he perceived the possibility of reproducing the effects of permanent magnetism. Recently, towards 1879, he found that induced magnetism may likewise be explained by these hypotheses and represented by actions of this kind. Not till then he made experiments and thus gave a confirmation to the results of his calculations.

The same process has led him to conclude that the action of currents may be represented in the same manner. In place of bodies in vibration bodies are required in a state of alternative rotation. The effects are much more difficult to demonstrate and viscid liquids must be employed.

Nevertheless the experiments have been made. Hitherto the attractions and repulsions have not been exhibited. I do not know if M. Bjerknes has obtained them; but by the means indicated, the lines of action, the electric figures, if I may so express myself, have been traced. They are very curious. If we suppose the current perpendicular to the plate and brought in presence of the pole of a magnet, we see very well the influences produced around it; the figures are especially striking in the case of two currents. M. Bjerknes does not yet appear to have drawn from these experiments all that he expects. Still they have already led to important consequences. Thus calculation, confirmed by experiment, has led him to renounce the formula proposed by Ampère, and to adopt the formula of Regnard as modified by Clausius. More prolonged experiment must decide whether he is right.

These researches present special difficulties, and the use of viscid liquids is open to discussion. M. Bjerknes has made use of them in reproducing the effects which he obtained in water, and finds that the lines of force are no longer the same and that the phenomena are modified. It is, therefore, necessary to depart as little as possible from perfect liquids. The experimenter seeks at present to make use of such liquids in cylinders with fluted surfaces—an expedient not without difficulty.

This series of experiments is a rare instance of the verification of algebraical calculation by direct demonstration. In general we employ geometry, which gives by calculation a graphic representation, furnishing a valuable control; sometimes we have a practical application which is in some respects an important verification, though merely approximative in others. It is exceptional to give, as M. Bjerknes has succeeded in doing, a direct material reproduction, which, whilst it brings the results into a singular prominence, enables

› be compared with known facts, and to gene- he views upon which they rest.

hypotheses on the nature of electricity being t indifferently established nothing which may their solidity should be neglected. That elec- s a vibratory movement is perhaps no longer ıl, but it is not yet as clearly established as in ː of light. Every proof in support of this idea ›me, especially when it has not been furnished ad of accident, but springs from mathematical ion.

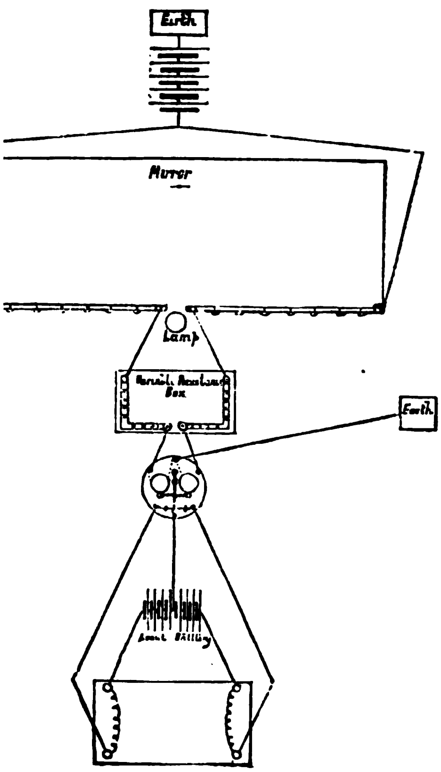
ı this double point of view the experiments of kues are very remarkable. I add that they are ırious to see, and I commend them to the ıtion of all visitors to the Exhibition.—*La Lu- Electrique.*

Correspondence.

]RDING APPARATUS FOR MIRROR SIGNALS.

he Editor of THE TELEGRAPHIC JOURNAL.

-On the 15th ult. I wrote the accompanying r insertion in a scientific periodical, inclosing riend of mine who happened to be staying in for a short time. By the following mail I sent ːrawing and specification asking him to patent



Recorder

gement if I were not forestalled by so me one that case I requested him to retain th e letter, I inclose a copy. On the 14th inst. I received m to say I had been forestalled, and c ould not patent. I now inclose a duplicate of my former letter, to show that the plan of registering mirror signals by the aid of selenium, has been for some time known to several members of the Eastern Telegraph Company's staff, although neither experimentally tried, patented or published. We may as well claim our meed of credit, though the commercial success be wanting, lest the public should imagine that "they manage these things better in France," or in Belgium. I have heard nothing as yet (beyond my inability to patent) from my friend in London, as he was to sail at once on a cable expedition. I inclose a sketch and description of my arrangement, consoling myself with the satisfaction of evolving a new formula, viz., that the chance of success in invention is inversely proportional to the square of the distance of—one's residence from London.

Yours,

HENRY N. BLACKWOOD PRICE.

Candia, Crete (Turkey in Asia),
Sept. 17th, 1881.

SIR,—I read with great interest in your issue of the 30th ult. that M. Paul Samuel has laid before the Academy of Brussels an apparatus for the purpose of recording mirror signals, by letting the light fall on selenium cells. I am sure that M. Paul Samuel is not the only man by scores who has perceived the advantage derivable from the recording of mirror signals, and that many plans have been devised for that purpose, but without any result which might be considered as a commercial success. Some few years ago the same idea, now brought forward by M. Samuel, occurred to me, and I communicated it to two or three friends, who advised me to bring the matter forward. But for reasons which I shall mention, it became evident that without considerable development the idea was without practical value. For short cables the Morse system is fully satisfactory, especially since the introduction of the relays of Messrs. Brown and Theiler, whose ingenious jockey-armature system neutralises the effect of fluctuating earth-currents and variations of potential, not dependent on the battery current of the sending station. It is therefore only on long cables that a substi tute for the beautiful but costly siphon recorder of Sir William Thomson can be used. Various systems have been tried for registering mirror signals; that by means of photography, more than once; but the difficulties of rapid development and fixing of the signals prevent a speed being attained sufficient to make such an instrument a commercial success. Hitherto, unfortunately, the selenium plan has not been more successful than its predecessors, as far as regards long cables, on account of that very moving zero which Messrs. Brown and Theiler have so successfully eliminated in their relays by their jockey armature. Any of your readers who are accustomed to see mirror signals from long cables, will tell you that the spot of light does not return to zero after each signal, but that when three or more deflections on the same side of the scale follow one another (as in the cases of H or 5) without reversal of the current, the spot merely moves a little further up the scale, to the right or left, as the case may be. Thus, with *two* selenium cells, there will be on long cables no distinction of the signals, unless M. Samuel has made some arrangement to regulate the current passing through the relay in proportion to the passage of the spot of light up and down the scale. This I believe may be done by using not merely two, but several pieces of selenium on each side of the zero point, arranged to give rise to a current, of a strength increasing in proportion as the light is distant from the zero point. If this is done we may have not merely registration of mirror signals, but translations on long mirror circuits, and work direct from London to

Bombay, by sea as well as by land. It is only fair to say that the latter plan I have never tried, as my present station, though a very pleasant residence is, as far at least as such experiments are concerned, unsuitable for scientific research. Pardon my trespassing on your space at such length.

Yours, &c.,
HENRY N. BLACKWOOD PRICE.

Candia, Crete (Turkey in Asia),
August 15th.

The arrangement (which is shown by the sketch on page 403) is to be adapted to Sir William Thomson's Mirror, for the purpose of either recording signals, or if necessary, automatically re-transmitting signals to a distant station. The scale of the mirror is composed of a number of pieces of selenium, separated by insulating material, but all joined in the same circuit. When unaffected by light, the two sides should have as nearly as possible the same resistance, but the pieces of selenium are so selected and arranged, that when affected by light each has less resistance in proportion as it is distant from the zero point. Any slight difference in the resistance of the two sides of the scale may be balanced by the resistance box represented in the drawing. It will be seen by the sketch, that the battery current splits between the two sides of the scale, thence goes through the resistance, and through the coils of a Brown's relay (*see* "Telegraphic Journal," May 15th, 1877) differentially wound. Whichever the piece of selenium affected by the light may be, the armature of the relay is affected in exact proportion. The movements of the spot on the scale, whether on opposite sides or on the same one, will always be followed by the closing of a circuit, in consequence of the well-known action of the jockey armature. The closing of the local circuits on each side of the relay may, of course, be made to work either an acoustic, recording, or translating instrument. In place of using a number of pieces of selenium for the scale arranged proportionally, it may be preferred to admit more or less light in the necessary proportions. This may be done by coloured glass, excluding more or less of the greenish-yellow rays, which have the strongest effect on the selenium.

CITY AND GUILDS OF LONDON INSTITUTE EXAMINATIONS.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—Your issue of the 15th inst. contains a letter complaining of the high standard required at the above examinations. I would remind the writer that if the certificates are to be worth anything, the standard must be high; it is a mistake to have it so low that any body can pass with a little study.

A certificate to be of any use should be a guarantee that the holder has a good knowledge of his subject, elementary or advanced, as the case may be.

With reference to the plan of giving twelve questions, all of which may be attempted, I may say that at the examination in May last I answered eight, and obtained a "First Class Advanced," proving that the student need not "hurry through them in such a way that he cannot do justice to himself."

The higher the standard, the greater the satisfaction in passing. To those who have failed I say, "Try again."

J. W. W. B.

September.

ELECTRIC LIGHT.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—In reply to Mr. John E. Chaster's letter in *your Journal of the 1st inst.*:—the engine on the Thames Embankment drives nightly, and has done so for a long period, 60 Jablochkoff lights, sometimes 70, of over 300 candles naked, and say over 250 in the frosted globes. Twenty horse-power (actual) would drive 30 Jablochkoff lamps, which, yielding, say, 250 candle power globed, would be equal to 7,500; while, according to your correspondent's letter, 20 horse-power (actual) lit 200 Swan lamps, twelve candle power = 2,400, leaving a gain to the arc system of over 4,000. The flickering, as before-named, proceeds from one of two causes, the irregular driving of the engine, high pressure engines with long bands being hardly suitable, or from the pressure of extraneous matter in the carbons used. What your correspondent says touching the inability to test over 150 candle power may, in ordinary cases, be perfectly correct; but the Board of Works in testing the Jablochkoff candle, spent much time and labour, using a photometer invented and arranged by their engineer and chemist; by it they considerably reduced the light power attributed to the candle by the owners of the patent, and I have no doubt that if the proprietors of other systems of electric light require testing as to their lamp's real photometric value, being desirous of not advertising a light power which they do not possess, by application to the Board of Works their desires may be gratified.

Before concluding, a word on the lighting of the British Museum. The first system tried was the Jablochkoff. I was present at the inauguration. Perfect satisfaction was expressed by all connected with the library, and the appearance of the room, with the soft golden light emitted from the lamps placed on pillars around one half of the circle, was most pleasing as well as effective. The "Société Générale d'Électricité," of Paris, carried this trial out for the Council of the British Museum at their own expense, continuing same for several days, were much complimented and thanked; then asked to withdraw that other systems might be tried. Siemens' replaced Jablochkoff at, I understand, no expense to Siemens. From that time to the present that system has held its own, and, again, as lately announced, is to be renewed for the coming winter. Now, sir, why have other systems not been tried? The reason for renewing the "Pioneer" of electric lighting was to experiment upon all the known systems. That course the Council considered fair play; such has not been done, and Siemens, spite of the dropping of lighted carbon on the table of the library, has, as before said, held its own, reigning alone, though the most expensive of all systems, and, from its noisy accompaniments, rendering it the least desirable of any for a library.

Obediently yours,
"ELECTRON."

Junior Carlton Club.

Notes.

ELECTRIC TRAMWAY.—The first sod of the Giant's Causeway and Portrush Tramway was recently turned. This tramway is to be worked by electricity generated by water power, and is interesting as being the first installation of the kind yet made.

GALVANIC BATTERIES IN RUSSIA.—A circular from the minister of finance, St. Petersburg, officially published October 2nd, directs that galvanic batteries, induction apparatus, and insulated wires imported from abroad shall in future be subject to the same rules of inspection and control as are in force for imported arms.

THE CRYSTAL PALACE ELECTRICAL EXHIBITION.—The Lord Mayor has convened a meeting at the Mansion House of the honorary council of the international electrical exhibition for Monday, October 24th, at 2.30 o'clock, for the purpose of receiving a report from the directors of the Crystal Palace.

TELEGRAPHIC COMMUNICATION WITH LIGHTHOUSES.—At the request of more than 1,200 of the citizens of London the Lord Mayor has called a meeting at the Mansion House for Tuesday, October 18th, to consider the need of establishing telegraphic communication between lighthouses and lightships and the shores, with a view to prevent, as much as possible, the great loss of life from shipwrecks on our coasts.

ELECTRIC RAILWAY.—The completion and opening of a second electric railway at Berlin will shortly take place.

MEASUREMENT OF THE ROTATION OF THE PLANE OF POLARISATION OF LIGHT UNDER THE MAGNETIC INFLUENCE OF THE EARTH.—By M. H. Becquerel.—It results from the experiments of the author that the yellow rays, D, traversing horizontally a column of 1 metre of sulphuret of carbon at 0° cent. under the influence of terrestrial magnetism at Paris and in a direction parallel to the dipping-needle, undergo a simple magnetic rotation of 0·8697 from the right to the left for an observer supposed to be laid horizontally with his head towards the magnetic north. This number is a natural constant, by means of which it is possible to convert all the determinations of the magnetic rotations of the plane of polarisation of light into absolute measurements, and it also furnishes a means of valuing the intensity of a magnetic field by simply observing the phenomena of rotatory polarisation to which it gives rise. In the system of units, C, G, S, (centimetre, gramme, second) adopted by many physicists the above number leads to the number 1·31 × 10—5 as an expression for the magnetic rotation of the yellow rays through sulphuret of carbon between two points distant from unity in a magnetic field equal to unity.—*Comptes Rendus.*

ON TELEPHONIC LINES CONSIDERED AS LIGHTNING CONDUCTORS.—By M. BÈDE.—The author considers that a line of 100 telephonic wires of 2 millimetres in diameter will be equivalent to a lightning-conductor of 3·14 square millimetres in section and with excellent contacts. If this line passes over a hundred houses it will protect them all equally.—*Le Technologiste.*

L'Electricité pronounces the arrangements of the Electrical Exhibition as regulated by M. Cochery, the French post-master general, to be in defiance of logic and reason.

ACCORDING to the *Zeitschrift für Angewandte Electric*, the telephonic system in Hamburg comprises 150 telephones, but the distinctness of the transmission of sounds is far from perfect.

IN our last issue we stated that the Lachaussée-Lambotte machine and lampes soleil were at present at work at the "Royal Aquarium, Westminster"; this should have been, the "Westminster Panorama."

ELECTRICAL EEL.—Professor Dubois-Raymond has just published an account of the researches of the late Dr. Sachs on the electrical eel (*gymnotus*) of Venezuela.—*Comptes Rendus.*

THE LATE PROFESSOR CLERK MAXWELL.—The delegates of the Clarendon Press will shortly publish an "Elementary Treatise on Electricity," by the late Prof. James Clerk Maxwell, edited by Mr. W. Garnett, formerly Fellow of St. John's College, Cambridge. The book was commenced about seven years ago, but its completion was prevented by the author's other engagements; so that during the last three years of his life very little was added to the work. After his death the first portion of the manuscript, on Statical Electricity, was found in a finished state, as well as some chapters on Current Electricity. The book has been completed so as to cover the subjects included in the first volume of the larger Treatise on Electricity and Magnetism by a selection of some of the simpler articles from the last-mentioned work. As in the larger treatise, the "method of Faraday" has been followed throughout; but no knowledge of the higher mathematics has been assumed, and geometrical methods have been almost everywhere adopted. Very much of the matter contained in the work will, we are informed, be new to readers who had not the advantage of attending Prof. Maxwell's lectures at Cambridge, and the whole book bears indelibly the stamp of Prof. Maxwell's originality. It is as much unlike any other book on electricity as the "Theory of Heat," or "Matter and Motion" is unlike other books on thermodynamics or mechanics. The Clarendon Press likewise have nearly ready for publication a second edition of Prof. Clerk Maxwell's "Treatise on Electricity and Magnetism," edited by Mr. W. D. Niven, Fellow of Trinity College, Cambridge.—*Nature.*

THE ELECTRIC LIGHT AT GODALMING.—The town council of Godalming have accepted the tender of Messrs. Calder and Barret to light up the streets with electric lamps, the current being supplied by machines driven by turbines. The town will ultimately have three Siemens' arc-lamps and forty of Swan's incandescent lights, which will be placed in the lanterns used for the gas-lights. The three Siemens' lamps have been used since Saturday last, and it is expected that the installation will be completed in a week's time. The mills of Messrs. Pullman are also to be illuminated by electricity. The lighting of the town will, it is said, cost 19 per cent. less than the gas estimate, while there will be double the quantity of light.

THE ELECTRIC LIGHT ON BOARD SHIP.—The two Spanish cruisers, *Gravina* and *Velasco*, now approaching completion by the Thames Iron Works and Shipbuilding Company, Blackwall, are to be fitted with large electric lights for "search" purposes, such as are now being extensively employed in the British and many foreign navies.

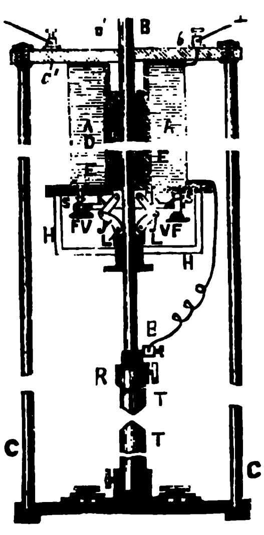
DR. SIEMENS.—Dr. C. W. Siemens has received from the French Government a formal document nominating him "Officier de l'Instruction Publique," the nomination being accompanied by the insignia of the order.

A NEW ELECTRICAL JOURNAL.—A new electrical journal, *Le Moniteur Officiel de l'Electricité*, has lately appeared in Paris.

THE GERMAN UNDERGROUND TELEGRAPH SYSTEM.—The imperial German subterranean telegraph net projected some years ago has been completed. It connects 221 towns and cities, and stretches from Königsberg to Strasburg, from Breslau to Emden, and from Thorn to Aix-la-Chapelle. The first underground cable of the system was laid in March, 1876, from Berlin to Halske,

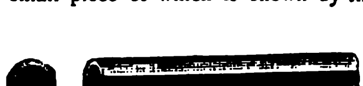
and the last portion of the net, extending from Cologne to Aix-la-Chapelle, was imbedded this summer. The laying of all these cables has taken about 58 months, and cost the empire, in round numbers, about 30,200,000 marks. The total length of the subterranean cables is 5,463,050 kilometres, and that of the wires contained in them 37,372,871 kilometres, 18 of the 23 lines being seven-wired and five four-wired.

ELECTRIC LAMP.—A patent for an electric lamp (No. 246,957, dated June 14th, 1881) has been taken out in the United States by Edward R. Knowles. This lamp, which is shown by the figure, has a magnet connected with the generator of electricity, in combination with a hollow armature-core surrounding the upper-carbon holding-rod, and two compound levers, the



upper arms of which are secured to the armature-core, the lower arms having inner cam-shaped ends to form a clutch, being secured to a sleeve passing around the carbon-holding rod, said levers being alternately tightened and loosened by the rising and falling of the armature-core.

TELEPHONE WIRE TO OVERCOME INDUCTION.—A new kind of wire for overhead telephonic circuits has recently been brought out in the United States by the firm of G. M. Mowbray of North Adams, Mass.; this wire, a small piece of which is shown by the figure,



consists of an insulated core of copper wire (No. 16), sheathed with iron, the two forming a complete metallic circuit. The protective iron sheathing, which envelopes the insulated copper conducting wire, and which forms a split tube, overcomes all inductive interference.

THE MAGNETO-ELECTRIC MACHINE OF C. DUBOIS. —In this machine (German patent, No. 100, 22), the exciting electro-magnets have the form of a wreath or crown. Each electro-magnet consists in the first case of a ring of soft cast iron, made up of round parts surrounded with coils of isolated wire alternating with check-pieces in which positive and negative poles are alternately produced, by the battery-current traversing the coils. The action is therefore the same as if two electro-magnets were connected by their corresponding poles. The coils to be induced, fastened to discs of wood, revolve between the electro-magnets. —*Zeitschrift für Angewandte Electric.*

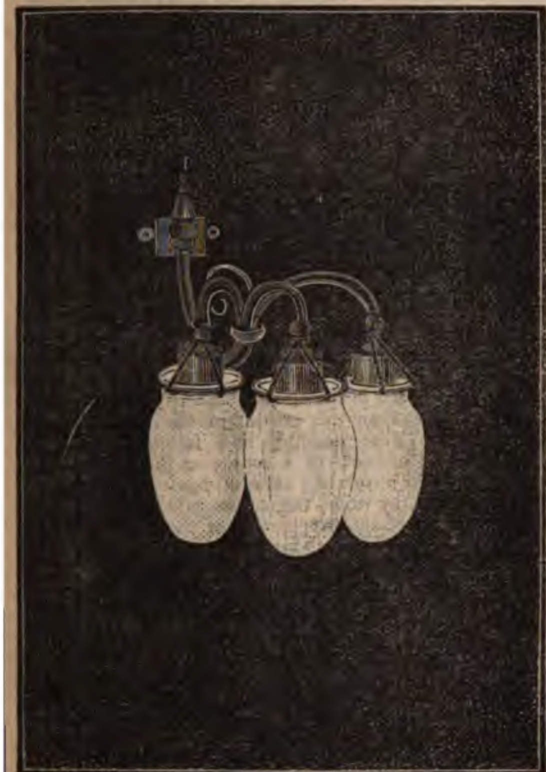
A NEW electric revolving light, to be placed on South Head, Macquarie Harbour, Sydney, was recently exhibited by the makers, Messrs. Chance Brothers, of Birmingham. It is a first-order, dioptric revolving light, with electric arc, and will, when erected in its house, form the most powerful lighthouse in the world —the merging beam from the apparatus being calculated to exceed in luminous intensity twelve million candles. The electric arc, which is supplied by a De Meritens machine, has a power of 12,000 candles, the machine being worked by an Otto engine of eight horse-power.

GRAHAM BELL'S (*sic*) INDUCTION BALANCE.—The *Operator* says:—We have heard nothing lately, by the way, of Professor A. Graham Bell's famous induction balance. That delicate instrument located the ball in the body of our late-lamented President, indicating the front of the right side of the abdomen, just above the groin, as the precise spot. Yet, cold facts, the result of the autopsy, located the ball far away on the other side of the body, and in the back instead of in front. They had better sell out that stock of induction balances.

TELEPHONIC TRANSMISSION OF OPERATIC MUSIC.—One of the attractions at the Paris Exhibition is the transmission of the music from the Opera to the Exhibition every evening. The transmitter employed is a compound michrophone, with pencils and blocks of carbon made upon the Crossley principle, a number of these instruments being fixed near the footlights on the stage. Although this is very interesting, there is really nothing new in the feat, as we described in our columns as long ago as 1879, vol. vii., page 145, some experiments made in the transmission of the services from a church to a distance of some 35 miles by means of the Crossley transmitter. We find, on inquiry, that since we wrote the foregoing, the transmitter named has been regularly employed every Sunday in this useful capacity for the benefit of an invalid, about two miles distant from the church; while often friends of Mr. Crossley's at Saltaire, 15 miles away, also enjoy the privilege of being included in the same circuit. The concerts from the St. George's Hall, in Bradford, have often been transmitted to Halifax, a distance of 10 miles, ever since 1879, for the benefit of audiences at *conversaziones*, &c., in Halifax, and this method of transmitting concerts, &c., has become a regular institution.

THE SAVOY THEATRE.—Mr. D'Oyley Carte gave the opening performance at this theatre on the night of Monday, October 10th. The name originally intended for the building was "Beaufort," as mentioned in our columns previously. The date for the first performance was to have been Oct. 6th, but this had to be altered on account of some delay in getting so large an installation of electric light quite complete. On Monday, the auditorium only was lighted by electricity, the form of the lamps used being shown in the accompanying figure. It will be seen that the clusters consist of three small plum-shaped globes, of slightly ground glass, sufficiently large to inclose the ordinary size lamps of Swan. There are

1,200 of these lamps in the building altogether. The first circle is lit by six clusters of three lamps each, the balcony by 16 clusters of three lamps each, and the gallery also by 16 clusters of three lamps each. In and about the corridors and offices there are many lamps in position, and on the stage are: 1st, footlights of 100 lamps; 2nd, above the stage, five battens



of 100 lamps, and one batten of 50 lamps; 3rd, at the side of the stage, four pilasters of 14 lamps, and two pilasters of 18 lamps each. The apparatus provided for this enormous display are six Siemens' alternating current machines and four exciters; two of the latter (of a large size) excite two each of the alternating current machines, the other two excite only one each. Fowler ploughing engines of 14 horse-power *nominal* were first used as the motive power, but we believe other and more powerful engines will soon be substituted for them.

New Patents—1881.

4165. "Telephone exchange apparatus and systems." E. D. PASS. (Communicated by F. Shaw and W. A. Childs.) Dated September 27.

4168. "Governing apparatus applicable for dynamo or magneto-electric machines, and for the usual forms of electro-motors." W. P. THOMPSON. (Communicated by W. J. Langley.) *Complete.*

4174. "Electric lamps and the manufacture thereof." E. G. BREWER. (Communicated by T. A. Edison.) Dated September 27.

4193. "Electric lamps." C. H. GIMMINGHAM. Dated September 29.

4194. "Apparatus for intermitting audible signals." F. W. DURHAM. Dated September 29.

4202. "Incandescent electric lamps." J. W. SWAN. Dated September 29.

4207. "Dynamo-electric machines." C. A. BARLOW. (Communicated by A. de Meritens). Dated September 29.

4227. "Insulators for animal magnetism." J. LYON.

4255. "Secondary galvanic batteries or electrical accumulators." A. WATT. Dated October 1.

4271. "Electro-magnetic apparatus." W. R. LAKE. (Communicated by A. Dobrochokoff Maikoff and N de Kabbath.)

4294. "Manufacture of incandescent electric lamps." A. G. SCHAEFFER. Dated October 4.

4296. "Conduits or recipients for telegraphic or telephonic conductors laid in streets or roadways." C.D. ABEL. (Communicated by L. A. Brasseur and O. Dejaer.) Dated October 4.

4304. "Dynamo-machines for the production and distribution of electric currents." H. AYLESBURY. Dated October 4.

4305. "Electric lamps." H. J. HADDAN. (Communicated by L. Somzée.) Dated October 4.

4309. "Galvanic or electric batteries." F. WIRTH. (Communicated by J. Stebbins.) Dated October 4.

4310. "Secondary battery." A. P. LAURIE. Dated October 4.

4311. "Electric lamps." J. H. JOHNSON. (Communicated by C. A. Faure.) Dated October 4.

4378. "Railway signals." H. CUTHBERT and G. H. SMITH. Dated October 8.

4383. "Improvements in the manufacture of electric bridges for incandescent lamps and in the means employed therein." ST. G. L. FOX. Dated October 8.

4396. "Manufacture of carbons for electric lamps and apparatus for that purpose." J. JAMES and J. C. F. LEE. Dated October 10.

4398. "Construction of secondary batteries or electrical accumulators." A. W. L. REDDIE. (Communicated by E. Volckmar.) Dated October 10.

4405. "Improvements in and apparatus for producing the electric light and in the manufacture of carbons therefor." A. M. CLARK. (Communicated by Joséphine de Chanzy.)

4409. "Manufacture of telegraph conductors and materials for covering and insulating wire or other conductors used for telegraphic, electric or other similar purposes." W. O. CALLANDER. Dated October 11.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1881.

474. "Galvanic batteries." JOHN CRISP FULLER and GEORGE FULLER. Dated Feb. 4. 2d. According to this invention there is employed in an otherwise complete galvanic element an additional separate porous diaphragm or cell, which is adapted to hold a reserve of the exciting fluid or crystals such as is generally required for the purpose. The invention is more particularly applicable to the bichromic and sulphuric acid batteries. As applied, for instance, in chromic acid batteries the reserve would be chromic acid or bichromate of potash; in batteries in which sulphuric acid is used the reserve would be sulphuric acid; in a Daniell's battery sulphate of copper, and in a nitric acid battery nitric acid. (*Provisional only.*)

497. "Electro-magnetic induction machines. HENRY WILDE. Dated Feb. 5. Consists in a method of constructing electro-magnetic induction machines

with multiple armatures for producing electricity, by which their power and efficiency are greatly increased. In this improvement the metal wheels or discs in which the armatures are mounted are slit in a radial direction towards the centres of each iron armature. The armatures are also slit in a radial direction towards their centres, and are fixed in the wheels in such a position that the slits in the wheels and the slits in the armatures coincide or extend into each other.

539. "Electric lamps." E. G. BREWER. (A communication from abroad by Thomas Alva Edison.) Dated Feb 8. 8d. The object of one portion of this invention is to make a lamp in which the light giving portion is in a straight line in order to give a straight line of light, instead of a circular or elliptical one. To do this the glass neck in whch the carbon is held is extended upward in a vertical arm, so that the lower end of the carbon is held as usual, and the upper end supported by a suitable arrangement at the top of this arm, along which one of the conducting wires passes to

FIG.1.

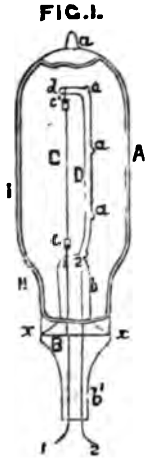


FIG.4

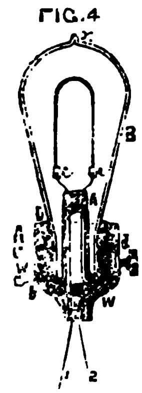


FIG.2.

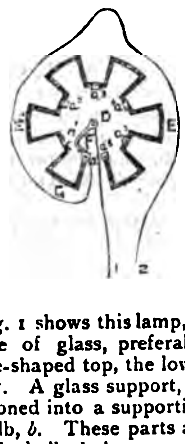
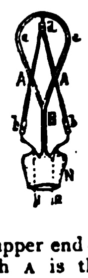


FIG.3.



the upper end of the carbon. Fig. 1 shows this lamp, in which A is the inclosing globe of glass, preferably cylindrical in shape, with a dome-shaped top, the lower end being drawn into a neck, N. A glass support, B, is made with its lower end fashioned into a supporting neck b^1, the upper part in a bulb, *b*. These parts are united at the line *x*, *x*. Upon the bulb, *b*, is secured a glass arm, D, rising to a little greater height above *b* than the length designed to be given to the carbon to be used, the arm, D, then turning at about a right angle, as shown at *d*. A conductor, 2, is secured to the arm, D, either by being fused therein through its length, or at intervals *a*, *a*, *a*, or by being bound thereto, or in any other convenient manner. The conductor, 2, has at its inner end a clamp, c^1, in which is secured one end of the straight flexible carbon filament, C, whose lower end is in clamp, *c*, upon the inner end of conductor 1. Conductors 1 and 2 pass through and are sealed into *b*.

The object of another portion of this invention is to furnish a device by means of which the light of a single lamp of an electric lighting system may be increased or diminished without affecting any others of the series, and to this end it consists in the interposition in the circuit of the lamp of a carbon resistance, the force of which may be varied at the will of the operator by simply turning a key. This arrangement is illustrated by fig. 2; B is a resistance made of stiff heavy carbon. Attached to it at various points are metallic contacts, *a*, a^1, a^2, &c. The wire, 1, through which the current passes to the light, extends to the metal arm, F, in the centre of the resistance. The current thus normally passes through the wire, 1, the metal arm, F, the contact piece, *a*, and around through the carbon, C, to the wire, 2. But if it is desired to decrease the force of the light the arm, F, may be turned back until it reaches the contact, a^1, thus requiring the current to pass through the portion, G, of the carbon, and interposing so much additional resistance in the circuit. If a still further diminution of the light is desired, the arm may be turned back to the contact, a^2, and the resistance thus doubled, and so on until the whole of the carbon, E, E^1, is included in the circuit 1, 2.

The object of another portion of the invention is to prevent the fibre bending and falling over; this arrangement consists of a supporter (fig. 3) made of glass or other insulating material having a support at its upper end, by which the carbon is held erect.

The object of another portion of the invention is to furnish a different means for retaining a vacuum in the inclosing globe of the lamp. A socket of wood or other insulating material has a glass piece set into it which is somewhat in the form of the letter W, the central arch thereof extending up within the inclosing globe, and having the conducting wires passing through and sealed within it. The inclosing globe sets into this glass piece, both being ground so as to fit tightly together. The remaining space is partly filled with mercury, and a packing of rubber is used to keep the mercury in place. Fig. 4 is a sectional view of a lamp constructed in this way; W is an insulating base, usually of wood; A is the glass socket fitting therein. It is, when seen in section, somewhat of the form of the letter W, the central limb being extended upwardly and forming a support for the wires leading to the clamps, the wires being suitably sealed therein, this central portion extending up within the body of the globe, B. The socket, A, is ground at *a*, and the globe, B, correspondingly ground at *b*, so that they fit tightly together. A space, C, is thus left, which is filled in with mercury forming a liquid seal. Above the mercury is placed a rubber ring, D, which fits tightly and prevents the mercury from escaping. 1, 2, are the wires of the circuit by which electricity is supplied to the lamp. These wires terminate in the platinum clamps, *c*, which hold the carbon. A portion of the circuit is formed by the screw, *d*, which may be drawn back to break the circuit and extinguish the lamp, or *vice versa*.

579. "Electro-photographical receivers for telegraphs." HIPPOLYTE CHAMEROY. Dated Feb. 10. 6d. Consists of a system of photographing the movements of a mirror galvanometer by making the spot of light act on sensitised paper.

607. "Telegraphic or telephonic apparatus." P. M. JUSTICE. (A communication from abroad by Jacques Victor Michel Bartelous, of Brussels.) Dated Feb. 11. 1s. 4d. This apparatus enables the establish-

ment on a system of three wires, of an unlimited number of subscription stations or telegraphic offices, giving to each the right of calling a central office. By the help of this office the different stations can be put in communication with each other, or with other lines; for the time being all communication on the system is stopped, except between the "caller" and the "called."

639. "Preparing carbon and other conductors for electric lighting." WILLIAM ROBERT LAKE. (A communication from abroad by Hiram Stevens Maxim, of Brooklyn.) Dated Feb. 15. Relates to an improved method or process of preparing carbon or similar material for electric lamps or lighting apparatus, or for other electrical purposes, and is chiefly designed for use with lamps of that class known as incandescent, in which the light-giving portion is a continuous conductor of high resistance, commonly of carbon. The system generally consists in subjecting the carbon conductor while surrounded by an atmosphere of hydrocarbon vapour or other carbonaceous gas to the action of an electric current in the presence of some standard light or other means of determining when the conductor conforms to the standard fixed.

715. "Electric lamps, &c." J. G. TONGUE. (A communication from abroad by Dr. Auguste Lacomme, of Paris.) Dated Feb. 18. 2d. Has for its object improvements in and connected with electric lamps, and also for other lighting and heating purposes, and consists, first, of mounting two or more pairs of carbons or equivalents on an axis, so that after a definite time has elapsed, of a duration nearly equal to the time the carbons will last, the axis and connections receive a partial rotation by means of a current attracting an armature, or by an apparatus driven from the engine, for example, a worm and wheel, or an arrangement of gearing so timed for speed as at a certain point of the revolution to transmit a current to the lamp, and so cause a fresh pair of carbons to appear uppermost, where it is locked until they are nearly consumed, when the operation again takes place. (*Provisional only.*)

774. "Electric lamp." JAMES FYFE. Dated Feb. 23. 2d. Relates to electric lamps in which the regulation of the carbons is effected by means of two solenoid coils, one of which, being of low resistance, is included in the lamp circuit, while the other, being of high resistance, is in a branch circuit connecting the conductors to and from the lamp. The invention consists in certain constructions and arrangements, whereby the regulating coils can be placed at a distance from the carbons. (*Provisional only.*)

785. "Covering wire for electrical purposes." W. E. AYRTON. Dated Feb. 24. 4d. Relates to the covering, and the more compact and orderly arrangement of three or more wires for conducting electrical currents in a more or less parallel direction and alongside each other, by weaving them together with a woof of silk, cotton, or other fibrous material, the wires themselves forming in such case the warp of such web or ribbon; or *vice versâ*, the wires may be the woof, whilst the covering forms the warp.

792. "Electric lamps, &c." PETER JENSEN. (A communication from abroad by Thomas Alva Edison, America). Dated Feb. 24. 6d. Consists, generally speaking, in making the density of the carbons, in incandescent lamps, where a series of lamps are to be used, proportionately greater than that of the standard lamp, their conductivity increasing and resistance decreasing proportionately, so that with the standard amount of energy and the standard amount of electro-motive force or pressure, each lamp of such series shall give the standard amount of light; the radiating surfaces of each remaining approximately at the area of radiating surface of the standard lamp.

844. "Galvanic batteries." FRANK WIRTH. (A communication from Edwin Moriz Reiniger, of the University of Erlangen.) Dated Feb. 28. 2d. Relates to galvanic batteries designed for therapeutic purposes, but is also applicable to other galvanic batteries, and has for its object to facilitate their transport. (*Provisional only.*)

1395. "Electrical apparatus for transmission of sound." W. R. LAKE. (A communication from abroad by Amos Emerson Dolbear, of Somerville, America.) Dated Mar. 29. 6d. Relates to the telephone referred to on page 212 of the No. of the Journal for June 1st.

2256. "Supporting structures for electric wires or conductors," &c. W. R. LAKE. (A communication from abroad by William Clare Allison, of Philadelphia.) Dated May 24. 6d. Relates to supporting structures or supports for telegraphic, telephonic, and other electric wires, and also for electric lamps, and consists in arching the streets from curb to curb, diagonally from the four corners at the intersection of two streets. It also consists in simply springing an arch from curb to curb in the middle of the square, and in certain modifications hereinafter described.

2394. "Electric circuits." SYDNEY PITT. (A communication from abroad by Orazio Lugo, M.D., of New York.) Dated May 31. 6d. Relates to the patent described on page 258 of the number of the Journal for July 1st, 1881.

2593. "Electric clocks." A. M. CLARK. (A communication from abroad by Jakob Schweizer, of Solcure, Switzerland.) Dated June 14. 6d. Relates to an electric clock in which a weight at the end of a lever, which is lifted up periodically by an electro-magnet, drives the mechanism.

City Notes.

Old Broad Street, October 12th, 1881.

DIRECT SPANISH TELEGRAPH COMPANY.—The sixteenth ordinary general meeting of the above Company took place Sept. 30th, at the offices, 106, Cannon-street, Mr. N. Bannatyne in the chair.—(*See* "Telegraphic Journal," Oct. 1.) The chairman, in moving the adoption of the report, said that the results of the working of the past half-year caused them to entertain more favourable hopes of the future of the Company than they had held for some time. He looked with great satisfaction at the addition to the reserve fund, having long maintained that one of the first things to be considered by the directors of a cable company was the establishment of a substantial reserve fund. That was the only thing which could give stability to the property of the company, and render them in the long run independent of those casualties to which a submarine cable was so liable. With regard to their future prospects, he was glad to say that the traffic for the first three months of the present half-year had been highly satisfactory, and they had no reason to doubt that it would be good for the next three months; and if they had no mishap he believed that they would be able to meet them under

more satisfactory circumstances than on that occasion. Their cable and land lines continued to work perfectly, the high electrical condition of the submarine cables showing no variation; and they were in a position to deal satisfactorily with any additional amount of traffic, which he thought it was only reasonable to expect, in consequence of the very improved state of business and matters generally in Spain and elsewhere. One advantage which would result from the improved position of the Company would be that in the future they hoped to be able to pay the dividends immediately after the meetings. Mr. Abraham Scott seconded the motion, and in reply to questions the chairman said that eventually they hoped to be able to invest the reserve fund permanently. It was now, however, in a perfectly safe position, and available within a week or a fortnight. The Spanish Government dealt very fairly with them. They were not bound to pay the Company the money they received on account of the Company till six months afterwards, whereas they generally paid it within four months. The report was unanimously adopted, and the dividends recommended were declared, the meeting terminating with a vote of thanks to the chairman and directors.

GREAT NORTHERN TELEGRAPH COMPANY.—Under date 30th September, we are informed that the Japanese Government lines are again in perfect working order. The Company's lines to China continue to work well.

BRAZILIAN SUBMARINE TELEGRAPH COMPANY (LIMITED).—The accounts of this Company subject to audit show a profit sufficient to enable the payment of a final dividend of 3s. per share, making a total dividend of 6 per cent. for the year ended 30th June, 1881, and also the payment of a bonus of 2s. per share, which together will amount to £32,500, being a distribution in the aggregate of 7 per cent. for the past year, leaving a balance of £54,510, of which amount £50,000 has been placed to the reserve fund, increasing that fund to £345,349; and £4,510 is carried forward.

REUTER'S TELEGRAM COMPANY.—An interim dividend at the rate of 5 per cent. per annum for the half-year ending June 30, has been declared.

SUBMARINE CABLES TRUST.—The coupons due on the 15th inst. will be paid by Messrs. Glyn, Mills & Co.

EASTERN EXTENSION TELEGRAPH COMPANY.—The report of this company states that the gross receipts, including government subsidies, have amounted during the half-year to £191,580, against £173,020 for the corresponding period of 1880, showing an increase of £18,560. The working and other expenses (including a sum of £21,843 for cost of repair of cables and expenses of ships), together with income-tax, absorb £55,230 against £50,384 for the corresponding half-year, leaving a balance of £136,350. From this is deducted £41,595 for interest on debentures, and contributions to sinking funds for the redemption of the Australian Government subsidy and Manila debentures, leaving £94,755 as the net profit for the half-year. One quarterly interim dividend of 1¼ per cent. has been paid, and it is now proposed to distribute another of like amount, together with a bonus of 1s. per share, leaving a balance of £34,830 to be carried forward.

The following are the final quotations of stocks and shares: — Anglo-American, Limited, 52¼-53; Ditto, Preferred, 82-83; Ditto, Deferred, 23½-23¾; Brazilian Submarine, Limited, 11⅛-11⅝; Brush Light, ——; Electric Light, ¾-1; Consolidated Telephone Construction, ½-1½ A; Cuba, Limited, 9½-10; Cuba, Limited, 10 per cent. Preference, 16-17; Direct Spanish Limited, 5-5½; Direct Spanish, 10 per cent. Preference, 16-17; Direct United States Cable, Limited, 1877, 10¼-10¾; Debentures, 1884, 103-106; Eastern Limited, 10⅜-10⅝; Eastern 6 per cent. Preference, 13-13½; Eastern 6 per cent. Debentures, repayable October, 1883, 103-106; Eastern 5 per cent. Debentures, repayable August, 1887, 102-105; Eastern, 5 per cent., repayable Aug., 1899, 105-108; Eastern Extension, Australasian and China, Limited, 11⅛-11⅝; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 107-110; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 104-107; Ditto, registered, repayable 1900, 104-107; Ditto, 5 per cent. Debenture, 1890, 103-106; Eastern and South African, Limited, 5 per cent. Mortgage Debentures, redeemable 1900, 103-106; Ditto, ditto, to bearer, 104-107; German Union Telegraph and Trust, 10-10½; Globe Telegraph and Trust, Limited, 6½-6¾; Globe, 6 per cent. Preference, 12⅜-12⅞; Great Northern, 12¼-12¾; 5 per cent. Debentures, 103-106; India Rubber Company, 24-25; Ditto, 6 per cent. Debenture, 102-106; Indo-European, Limited, 28-29; London Platino-Brazilian, Limited, 5½-6; Mediterranean Extension, Limited, 2½-3; Mediterranean Extension, 8 per cent. Preference, 9½-9¾; Oriental Telephone, ⅜-½; Reuter's Limited, 11½-12½; Submarine, 280-290; Submarine Scrip, 2¾-3; Submarine Cables Trust, 99-103; United Telephone, ——; West Coast of America, Limited, 4½-5; West India and Panama, Limited, 1¾-2; Ditto, 6 per cent. First Preference, 7-7½; Ditto, ditto, Second Preference, 6-6½; Western and Brazilian, Limited, 7⅜-7⅞; Ditto, 6 per cent. Debentures "A," 110-115; Ditto, ditto, ditto, "B," 98-102; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 125-130; Ditto, 6 per cent. Sterling Bonds, 104-107; Telegraph Construction and Maintenance, Limited, 25-26; Ditto, 6 per cent. Bonds, 104-108; Ditto, Second Bonus Trust Certificates, 1⅜-1⅞.

TRAFFIC RECEIPTS.

NAME OF COMPANY.	AUGUST.	SEPT.	REMARKS.
	£	£	
Anglo-American... 1881	..	...	From July the publication of the receipts of this company are suspended.
1880	..	..	
Brazilian S'marine 1881	11,980	14,841	
1880	10,417	13,585	
Cie. Française ... 1881	...	...	Not published
1880	..	..	
Cuba Submarine... 1881	2,300	2,000	
1880	1,886	1,710	
Direct Spanish ... 1881	1,507	1,790	
1880	1,197	1,457	
Direct U. States... 1881	...	...	From July the publication of the receipts of this company are suspended.
1880	..	..	
Eastern 1881	42,797	47,407	
1880	40,988	41,717	
Eastern Extension 1881	30,349	30,866	
1880	30,169	28,771	
Great Northern ... 1881	21,200	22,280	
1880	22,800	23,320	
Indo-European ... 1881	...	...	Not published.
1880	..	..	
Submarine 1881	...	...	Publication temporarily suspended.
1880	..	..	
W. Coast America 1881	...	...	
1880	..	..	
West. & Brazilian 1881	7,745	9,530	
1880	7,001	9,575	
West India 1881	3,427	3,964	
1880	2,291	1,381	

TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. IX.—No. 210.

PARIS ELECTRICAL EXHIBITION.

THE BRITISH SECTION.

INDIA-RUBBER, GUTTA-PERCHA AND TELEGRAPH WORKS COMPANY.

exhibits of this Company are compre-
e, and consist of a varied assortment of
al instruments and other objects of interest
uted by the different departments of the
own works; the exhibits of the branch works
an-Beaumont, near Paris, are included in the
section.

CABLE DEPARTMENT.

ecimen case contains samples of "deep sea,"
mediate," and "shore end" cables manu-
d at the Silvertown works. The total length
raphic and torpedo cable made since 1866,
ts to 11931 knots, exclusive of 3180 knots
course of construction for the Central and
American Telegraph Company; the weights
e cables vary from 24 cwt. to 27 tons per

27-ton cable is the heaviest type hitherto
cted at Silvertown, and forms part of the
id last year by this company between Grosse
and the Bird Rocks, in the Gulf of St.
ce. On account of the precipitous nature
Bird Rocks, where the cable is landed,
e danger of the cable becoming jammed
ice, an exceptionally heavy type has to be

specimens include telegraphic cables made
British Government and Colonies, India,
, Russia, Peru, Chili, and Japan; there are
rpedo cables, of single, four, and seven core,
lied to the British Government and Colonies,
ited States, Spanish, Dutch, Chinese, and
ine Governments. Samples of gutta-percha
lia-rubber covered wires, of the description
the I. R. G. P. Co. supplies to the British Post-
he French, and other Governments, for their
ground systems, are also shown. The form
erground lines adopted in France differs from
the Post-office in being almost exclusively
d in leaden pipes.

OOKS' UNDERGROUND MULTIPLE CABLE"
, which has been in successful operation for
ears in the United States, and has also been
y the Post-office with very satisfactory results,
en fully described in the numbers of the
l for December 1st, 1879, and August 15th,

A short experimental line of 500 ft., with 28 conductors inclosed in pipes filled with petroleum—with terminal poles and oil reservoir complete—is to be seen fitted up in the Exhibition, the object being to show practically that the system is peculiarly adapted for avoiding inductive disturbances in telephonic circuits.

INSTRUMENT DEPARTMENT.

Amongst the "GALVANOMETERS" are the following:—"Thomson's reflecting astatic galvanometer," complete with shunts, lamp and scale. The four coils in this instrument admit of being coupled up in five different ways so that their total resistance can be made as follows:—1st, All coils in series; 2nd, $\frac{5}{8}$ the total resistance; 3rd, $\frac{1}{4}$ the total resistance; 4th, $\frac{1}{16}$ the total resistance; 5th, $\frac{1}{16}$ the total resistance, the galvanometer leading wires being in each case connected to the same terminals.

"Thomson's reflecting marine galvanometer," complete with shunts, lamp and scale. "Small reflecting galvanometer," with oil vessel, shunts, lamp and scale (Government pattern). "Portable astatic galvanometer," in brass case, with jewelled centres, having 1,000 ohms resistance, in sling leather case, with controlling magnet. "Tangent galvanometer" (Post-office pattern), for testing with received currents, fitted with resistance coil, shunt and short-circuit key. "Speaking galvanometer," for submarine cable work, with lamp, condensing lens and scale stand. "Signalling key," for mirror speaking instrument (Silvertown pattern).

The "RESISTANCE COILS" shown are:—Large set of "Wheatstone bridge resistance coils" (Dial pattern), arranged in units, tens, hundreds and thousands; with proportional parts of 10, 100, 1,000, and 10,000 ohms. Set of "Wheatstone bridge resistance coils" (Post-office pattern), fitted with battery and galvanometer keys, in polished wood case with lock and key.

There are also exhibited "Speaking instruments," "Morse direct ink writers," a "Morse pony sounder instrument" (Post-office pattern), "Morse single current keys" (Post-office pattern), "Bain's fast-speed receiver," for automatic working, fitted with speed regulator, "Wheatstone's A B C instrument (induced magnets), consisting of indicator, communicator and clockwork bell.

Amongst the "RAILWAY SIGNAL INSTRUMENTS are:—"Walker's patent train describer," receiver and sender. By pulling forward a small lever opposite the name to be sent, and pressing back a similar lever at the name last sent, the "sender" attracts attention at the distant station by a single stroke on a bell, and at the same time indicates the name of the coming train on the "receiver," which is provided with a dial labelled to correspond, and a rotating pointer in the centre. "Walker's direct-action semaphore repeater," showing the three positions of the signal arm." Complete set of "Walker's electro-magnetic telegraph semaphores" for railway block signalling. Complete set of "Preece's single wire block signalling instruments," consisting of semaphore, switch and plunger. "Preece's double current light and

arm repeater." "Single stroke direct action bell," with key.

There are also shown the "Silvertown water-level indicator and contact-maker," for showing the rise and fall of water in reservoirs at the engineer's office, situated away from the reservoir. "Hall's patent anemometer, with telephone receiver," to indicate audibly at a distance the rate of air passing through underground workings in mines. The anemometer is of the ordinary cup form, and at every revolution causes a spring to vibrate in close proximity to the pole of a Bell telephone. The induced currents thus generated in the telephone coil being transmitted to the distant receiving telephone reproduce on it the sound imparted to the spring every time it is set vibrating. The number of these vibrations, or revolutions, in a given time, is an index of the rate at which the current of air passes through the workings.

A case of specimen "carbon rods," varying from 3 to 25 millimetres in diameter, for electric lamps, is also exhibited.

(*To be continued.*)

JAMES STIFF & SONS.

Messrs. Jas. Stiff & Sons, of London Pottery, Lambeth, exhibit a great variety of porous cells and cylinders, both red and white, also porous plates of all sizes. Their porous ware has for many years possessed a high reputation, and has been extensively used by some of the best electricians and telegraphic engineers.

Vitrified stoneware battery jars and telegraph insulators, of all the most usual shapes and sizes are, also exhibited by this firm. These goods have stood the tests to which they have been submitted in the most satisfactory manner. Models of retorts, receivers, acid pans, condensing coils, and other chemical apparatus, in brown and white stoneware, are also shown. Messrs. Stiff & Sons gained prize medals at Paris, in 1878, and at most of the other international exhibitions.

The illustrations which we give show some of the varieties of battery jars, insulators, etc., which are amongst the exhibits.

PHILLIPS BROS.

Messrs. Phillips Bros., of Mackintosh Lane, Homerton, London, exhibit a number of specimens of silk-covered copper wire for electrical purposes. These specimens are remarkable for the uniformity and closeness with which the coverings are laid on, qualities which are very essential for high class electrical instruments. Mr. R. E. Crompton is Messrs. Phillips' Paris agent.

ROBEY & Co.

isplay of steam power by Messrs. Robey
˙Lincoln (whose stand adjoins that of the
merican Brush Electric Light Corporation),
ne. A line of intermediate shafting, placed
mns about 12 feet from the ground,
; the power from the engines to two long
ɔrush dynamo-electric machines.
e engines are of the well-known patent
:ngine type (*see* TELEGRAPHIC JOURNAL,
ı, 1879), they are seven in number, varying
rom 10 to 40 horse-power nominal, and
)f giving out an aggregate effective power
250 horses.
ɔ horse-power engine is at present driving
› arc lights, and after careful experiments,
g over the usual evening run of three
: was found that the variation from the
speed, did not exceed one revolution
he whole of this time; this result being
ue to the special combination of automatic
r and equilibrium valve used on these
when employed for electric lighting.
rst three engines in the line of seven are
on to one length of shafting, the result
at any variation in one engine is absorbed
ther two, and an almost perfect uniform
: obtained. Thus, if three engines are
at full speed under their usual load, then
:ly turning a nut on the governor-spindle,
c done by any one engine may be doubled,
lt being not to increase the speed of the
but to halve the work done by the other
ines so that the total amount of work done
the same. If, for instance, the three
are indicating 10 horse-power each, then,
sting the governor of the centre engine
diagram indicates 20 horse-power, it will
d on applying the indicator to the other
that they are indicating only five horse-
each, the total power remaining the

are two great advantages in this arrange-
ıe first being that any slight variation is
ıtely absorbed, and amounts, in fact, merely
ıdency to variation; the second being that
ent of an accident to the governor, causing
boiler pressure to be thrown on to the
the speed of the shafting remains con-

remaining four Robey engines are each
an independent shaft, which shaft can be
up to form one continuous line of shafting
ecessary, friction clutches being used for
›ose; by this means any one of these engines
used for experiment without interfering
ı others. All the engines can be coupled
·, and any one of them can be stopped
dently of the others. It is worthy of obser-
hat these engines are all running very
at a moderate speed, and well within their
ties.

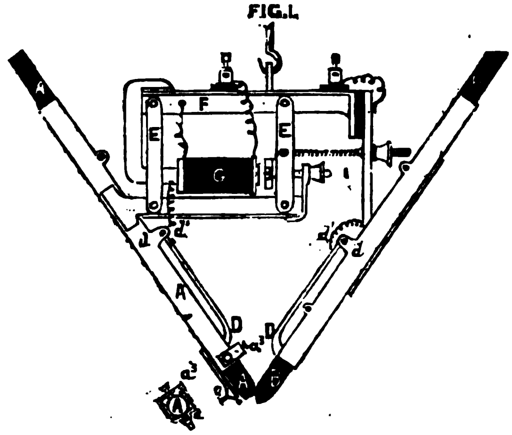
MR. KILLINGWORTH HEDGES

s his electric lamp, which has been specially
1 to avoid the complications of the ordinary
lamp where the regulation is effected by clockwork. In this lamp the carbons are so arranged that they are maintained at the proper distance by the action of gravity alone.

The apparatus used in the connection with the electric lighting of the Liverpool Docks is alone shown. The electric light has been used here for contractors' purposes for five years, and, as a proof of the durability of the generating machines, the same plant is now being used for the permanent illumination of the new docks.

The system employed is that of working a single light from each machine. For purposes where a large area is to be illuminated this is certainly the

FIG. 1.



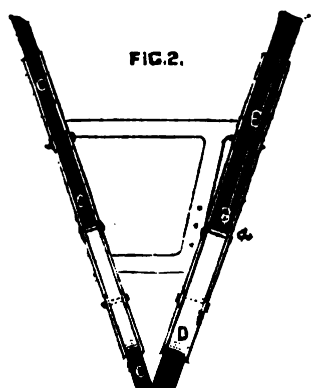


FIG. 2.

most economical mode of lighting: for not only is there a loss if the current is divided, but to enable the division to be carried out practically, each lamp must be fitted with a self-acting switch and an equivalent resistance to itself which comes into action if the lamp goes out. The generating machine must also be duplicated in order to provide against any accident to the one at work.

The deviator shown by Mr. Hedges provides against an accident to any number of machines working single lights, in the simplest manner. By having one machine running in open circuit, and consequently absorbing only the power required to rotate it, and connecting this to a bar similar to that in an ordinary resistance coil, then by inserting a plug, the spare current can be switched on to either one of the faulty circuits instantaneously.

It is usual to connect either of the circuits to an indicator, which shows a signal and strikes a bell should the current cease, so as to draw the attention of the attendant. Where the electric lighting plant is properly looked after, such a failure is very unusual; however, it is sometimes necessary to stop to adjust the brushes or look to a hot bearing, and the facility of applying a spare machine instantaneously is a considerable advantage, which in the single-light system can be employed at a very small extra cost.

Fig. 1 is a front view, and fig. 2 a side view of the Hedges' lamp. A is the negative carbon lying in an inclined trough or open tube, and butting near its end against an adjustable stop, *a*, so that the carbon descends as that portion of it against which *a* bears becomes consumed. The positive carbons, B and C, meet together at their ends, as shown in fig. 2, and one of these may be smaller than the other, so that the whole of the electrical current may pass through the larger, the smaller carbon becoming gradually consumed with it. The contacts for both the negative carbon, A, and the larger, B, of the positive carbons are made of pieces of metal, D, slightly hollowed to fit over the carbons, and hinged at higher points, *d*, to the troughs in which the carbons lie, the current being led to and from the contact pieces, D, by wires, d^1, escaping the joints of their hinges. The trough in which the carbon, A, lies is suspended by radius rods, E, E, from the upper framing, F, of the lamp to which the troughs for the carbons, B, C, are fixed. In the framing, F, is arranged an electro-magnet, G, having its coil in the lamp circuit, its armature, *g*, is attached to one of the radius rods, E, with a screw adjustment. When the lamp is out of circuit the end of the carbon, A, butts against the meeting of the carbons, B and C, but when an electric current is passed through the lamp, kindling the carbons where they butt, the electro-magnet, G, becomes excited and attracts its armature, *g*, whereby the end of the carbon, A, becomes separated from B and C, and the arc is established between them. As the carbons become consumed the two, B and C, continue to descend their respective troughs, the end of each supporting the other, and the carbon, A, advances, as permitted by the stop, *a*, so as to present its end at nearly the same distance from the ends of B and C. In order to render the stop, *a*, effective, an abutment screw, a^3, is provided at the upper side of the carbon, A.

James Fyfe.

Mr. James Fyfe, of 52, Queen Victoria Street, London, exhibits the Pilsen lamp (see *Telegraphic Journal*, December 15th, 1880), and also the Joel ndescence lamp (see *Telegraphic Journal*, November 1st, 1880). The Schuckert dynamo machine (see *Telegraphic Journal*, April 1st, 1879), which is also amongst the apparatus shown, has recently been tested by Mr. Schuckert in Paris with the following results:—

Machine Resistances.		Ohms.	Revolutions per minute.	H.P.	Resistances, Ohms. External.	Resistances, Ohms. Total.	Weber.	Volts. Total.	Volts. External.
Ring ...	...	5·7	700	5·5	27	40	9	360	243
Magnets ...	...	6·6	,,	5·0	30	44	8	351	240
Total Cold	...	12·3	,,	4·5	35	49	7·4	362	259
Warm ...	...	14	,,	3·8	40	54	6·5	351	260

At 720 revolutions, 6 Pilsen lamps with arcs 2 to 2·5 mm. wide and 7·5 to 8 Webers of current burn well with 4·5 h.p.

THE BRITISH ASSOCIATION.

ON A NEW SCREW GAUGE FOR ELECTRICAL APPARATUS.

By W. H. PREECE, F.R.S.

(Read before the British Association at York, Sept., 1881.)

It is very desirable to establish a gauge for the manufacture of various small screws used in the construction of telegraphic and electrical apparatus. Sir Joseph Whitworth, in England, and the Franklin Institute in America, have done this for the bolts and screws used in mill-work and engineering generally, but no one has extended either system to the finer work used in those numerous practical applications of electricity that are now becoming so important. Gauges and screw-plates are now as numerous as the makers engaged in the trade. Nettlefold's sizes of screws are, perhaps, those best known, but they are worked to a special gauge, starting from a diameter of 0·5 inch, which is numbered 32, and which has no known relation to any other gauge used in telegraphy. Whitworth's standard gauge for watch and instrument makers has not yet been adopted. The microscopical gauge is confined entirely to microscopes. There is, in fact, no fixed pitch, no form of thread, no recognised number of threads per inch, no gauge based on practice and experience. Hence inter-changeability for repairs is impossible, and the difficulty of applying for materials from abroad becomes very great. Screws are now generally supplied as "per pattern."

Sir Joseph Whitworth has remedied these defects in the larger forms of machinery, and, at the present moment, there is not a ship in Her Majesty's Navy which is not supplied with the same screws and the same threads. Many large engineering works, such as those at Crewe, are in the same happy condition. Sir

Joseph Whitworth carried his proposed standards for taps and dies to ·100 inch diameter, having 48 threads per inch, but his gauge has not come into general use for sizes less than ·250 inch diameter. I have placed myself in communication with most of the principal electrical apparatus manufacturers in England, and they have not only expressed their willingness to accept a well-conducted gauge, but have concurred in the view I have indicated of the present unsatisfactory condition of the question.

It fortunately happens that, from the point where Sir Joseph Whitworth and the Franklin Institute start in one direction, we can move in the opposite direction, so that, not only can the two gauges be made continuous, but though necessarily different in their applications, they can really be made uniform in their character. Indeed, the Whitworth gauge might itself, with slight modification, be extended.

It is only necessary for us to consider angular threads; square threads do not enter in such small work.

The Whitworth gauge specifies that the pitch of angular threads shall be equal to the depth which involves an angle of 55°, and that the top and bottom shall be rounded off to $\frac{1}{6}$th of the depth.

Screws of a diameter of $\frac{1}{4}$ in. (or No. A in the B.W.G.) have 20 threads to the inch. This is the starting-point of the American gauge, and both deal with increasing diameters. I propose to start from the same point, but to work in the opposite direction, dealing with diminishing diameters. Thus my starting-point is of the new No. 4 centimètre gauge, ·251 in. diameter, having 20 threads to the inch.

The exchange of apparatus between this and continental countries is now so general, that the adoption of the French decimal metrical system is well worth serious consideration. This is felt so much that in nearly every table of wire gauges the dimensions both in parts of inches and metres are given. The adoption of the metre as the unit length would secure adoption of the gauge abroad. The use of the inch as a unit leaves us in that singular insular position to which Sir William Thomson pointedly referred in Section A. the other day.

There are two dimensions besides the form and nomenclature to be considered, viz., the diameter of the screw and the number of threads per unit length. I suggest that the nomenclature be that of the wire gauge. The form I again refer to.

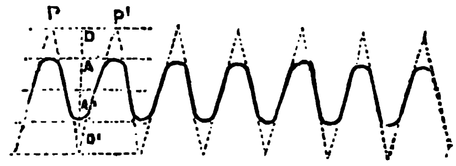
For the first dimension we might adopt a special number, as is done in the trade now, or we may take the same number for the screw and its diameter in *mils* or in millimètres, or, as I propose, we should adopt the new centimètre gauge recommended for adoption by the committee of the Society of Telegraph Engineers (December, 1879).

For the second dimension I propose to take the 5th multiple of the number of the screw in the new centimètre gauge as a factor. Thus No. 5 screw will have 25 threads to the inch, and its diameter will be ·225 in. No. 8 screw will have 40 threads to the inch, and its diameter will be ·161 in., and so on, as shown in the attached table, which embraces nearly all the screws now in use. In all other gauges the number of threads per inch is perfectly arbitrary. In fact, at present, even with the same gauge and the same kind of screw, the number of threads per inch varies.

Thus, if there is any value in my suggestion, we should have a simple nomenclature and a fixed gauge based on that already adopted for wires and plates, and easily remembered.

The attached diagram gives an idea of the character of the thread recommended by me for consideration. It has been carefully prepared with existing threads, and due regard has been paid to the essential requisites of strength, durability, and friction, but in the opinion of some, the depth of the thread is too deep in proportion to the diameter of the screw. In the small screws used for telegraphic and electrical purposes we need not consider the difference of metals employed.

There can be no doubt that a recognised gauge, with a distinctive name, based on a simple method, and



easily remembered, and supplied by such a house as that of Whitworth, will soon take root and be generally accepted, if stamped with the requisite authority.

I submit that the subject be referred to a committee of this section for consideration and examination, so that a new gauge may be recommended for adoption, with all the authority of the British Association.

PROPOSED TELEGRAPH SCREW GAUGE.

Gauge.	Threads per Inch.		Diameter.	
	Whitworth.	Telegraph.	Inches.	Millimètres.
4	20	20	·252	6·4
5	24	25	·225	5·7
6		30	·201	5·1
7	...	35	·180	4·6
8	32	40	·161	4·1
9	...	45	·144	3·7
10	40	50	·129	3·3
12	48	60	·103	2·6
14	...	70	·082	2·1
16	...	80	·066	1·7
18	...	90	·053	1·34
20	...	100	·042	1·07

A NEW DYNAMO-ELECTRIC MACHINE.

WE give an engraving of a new continuous-current dynamo-electric machine, recently perfected by Mr. Clinton M. Ball, of Troy, N.Y. This inventor has been engaged during some years past in building machines similar in type to the alternating current machine of Hefner-Alteneck especially in respect to the absence therein of solid metal parts in the armature, the latter being constituted in the form of a disc composed of a series of coils without iron cores, arranged and adapted to be moved in a magnetic field consisting of a series of poles of alternately opposite polarity on the same side of the disc, and facing opposite sides of the disc.

Mr. Ball has perfected several forms of continuous-current machines of this general type, and from among them we have selected two forms, which we illustrate. These machines have been operated with entire success at Troy; and samples of the machine are either already installed at the Paris Exhibition of Electricity, or are on their way to that destination, forming a part of the joint exhibit made by the "White House Mills" and Mr. Ball.

The bipolar machine, fig. 1, reproduces the effects

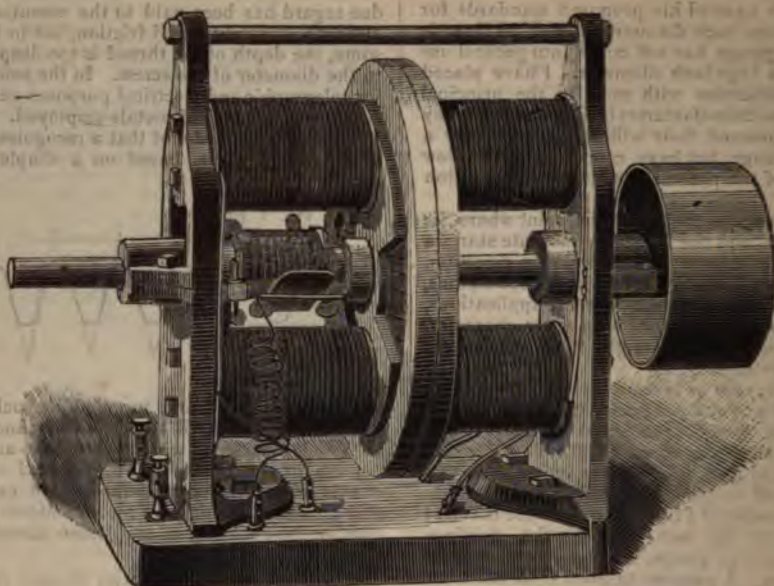


FIG. 1.—BIPOLAR DYNAMO-ELECTRIC MACHINE.

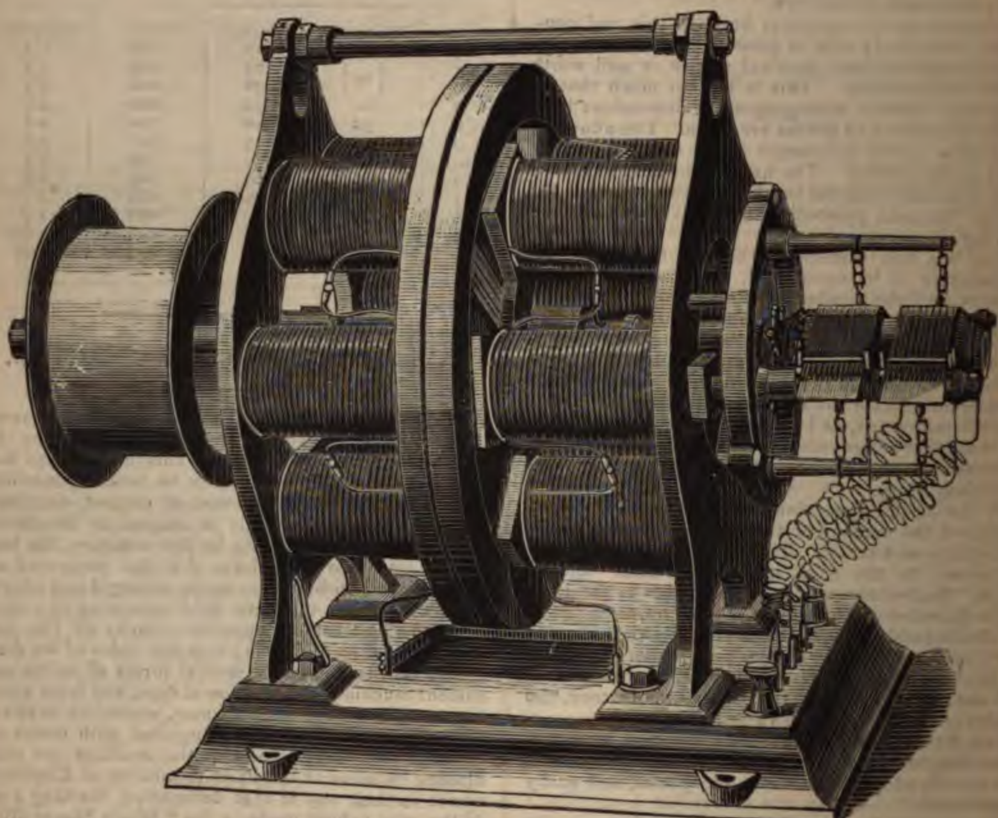


FIG. 2.—COMPOUND MULTIPOLAR CONTINUOUS-CURRENT MACHINE.

ll-known Gramme machine, over which it important advantages. Its special pecu- d advantages may be briefly summed up as The armature is composed of coils, six in ich of which occupies a sector of the disc hese coils are made self-supporting in the ut iron cores or metallic parts other than f which they are composed, and are con- continuous circuit. The commutator plates number, and constitute the terminals of rom the junctions between two contiguous ese commutator plates are usually disposed out the axis of the arbor of the machine so at opposite ends an angular displacement l parallelism of 30°. From this it results g rotation a pair of diametrically opposite armature are bi-circuited during one-twelfth ution at the neutral point of the machine, fect recurs successively through the entire oils. It will be understood that an important is gained by this arrangement, inasmuch stance of the inactive coils of the armature eliminated from the internal circuit of the This machine, used as a generator, presents d powerful effects with small expenditure of may be used as a very perfect form of an gnet motor. It runs without serious spark- commutator, and is simple and compact in on. A further noticeable feature, which hermore in all machines of this type, is the any noticeable external magnetic field when

er machine, fig. 2, is a compound multipolar -current machine, embodying characteristics ental arrangement which distinguish it from ; while, as before stated, in some of its l aspects it resembles the machine of Hefner-

chine represented in the engraving, it will be as only six opposite pairs of poles in the m. The continuous-current armature system chine has eight elements, and the commutator r plates. The armature is otherwise com- two sections or layers, the major section of utilised through a commutator or contact rdinary construction for doing work upon the ircuit, while the continuous current section the magnetism of the field.

machine, developed and constructed long publication of any description of Hefner- machine, the currents are commutated con- somewhat as in his machine, the commutator as being so made that while the contact brushes a fixed position, the currents are brought to the consequent electrical poles of the arma- consequent points, during rotation, assuming ly different positions in relation to the field, pleting the cycle of changes during half of a of the armature. During this time, further- line bisecting the armature and marking the t electrical points, has twice travelled over ete circuit of the field in advance of rotation. ase of a machine having more poles in the armature elements, the movement of this l be retrograde; however, if the multiple of umber of field poles into the number of arma- ents remained the same, the number of changes the same in either case.

be seen that this machine differs from that of lteneck in respect to the proportion of arma- ents to the number of poles of the magnetic Ball machine, having a larger number of elements than of field poles, while his has a less number. The arrangement selected by Mr. Ball is more favourable to a simplification of details of construction without detriment to the efficiency of the machine.

At a speed of rotation of 9,500 to 1,000 per minute, and with an expenditure of 5½ to 6 horse-power, this machine has proved capable of maintaining a series of ten to twelve arc lights of good power. The machine weighs only 850lbs.—*Scientific American.*

HERZ'S TELEPHONE SYSTEM.

By COMTE TH. DU MONCEL.

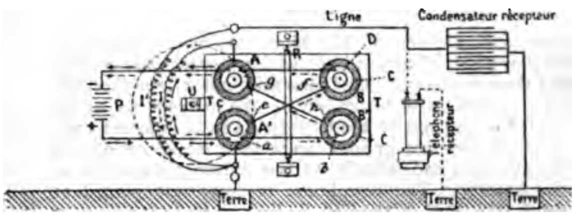
THE first system of Dr. Herz was based upon the employment of derivations, which system was new at the time it was published; the microphonic transmitter was placed in a derivation of the current to earth, placed at the end of the battery, and the different contacts of the microphone were themselves connected directly and individually to the different elements of the battery. The telephonic receiver was placed at the further end of the line, and when this receiver was a condenser, its armatures were, in consequence of this arrangement, polarised in a continuous manner, which enabled speech to be reproduced.

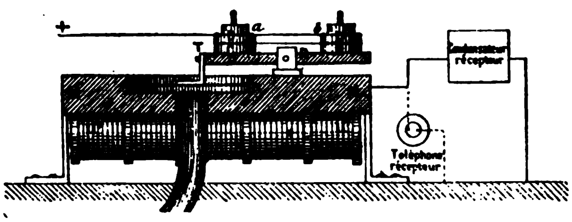
This arrangement evidently possessed advantages, but it had also its inconveniences, the most important of which was the necessity of employing rather strong batteries, and, consequently, the exposure of the line to some effects of charge which reacted in a troublesome way in the electrical transmissions when the latter took place over rather long lines. But as the chief aim of Dr. Herz was to apply the telephone to long lines, this question naturally occupied his attention. He thought at first of employing, as in telegraphy, reversed currents; but how was this result to be obtained with systems based on the employment of transmitters actuated by sonorous vibrations? This could be solved by the employment of secondary currents from induction coils, as has been done by MM. Gray, Edison, &c., but then benefit was only derived from the amplifications furnished by the derivations to the variations of pressure in the microphones; he therefore thought to increase the effects of the induced currents themselves by prolonging their duration, or rather by combining them so as to make them follow two by two in the same direction, and the following is the way in which the problem was solved.

It may be recollected that Dr. Herz had, in his first experiments, proved the efficacy of the microphonic contacts obtained by the superposition of discs of carbon or other semi-conducting substances. He employed them with various entirely different groupings, and in general the horizontal arrangement was found to give the best effects. Let us suppose, then, that four systems of contacts of this kind are arranged at the four corners of a plate of ebonite, C, C, as shown in figs. 1 and 2, by A, A', B, B', and that they are connected together in the manner shown, that is to say, the upper discs, *e*, *g*, *f*, *h*, parallel to the sides of the plate, and the lower discs, A, A', B, B', diagonally. Let us suppose also that the plate can turn round an axis, R, that the discs are traversed by small pins fixed in the plate, and that small discs of lead rest on the upper discs. Finally, let us suppose that the plate is connected at its edge to a telephone diaphragm, by an angle piece, T; it can be at once understood that the vibrations, produced by the diaphragm, will cause the

plate, c, c, to oscillate, and that there will result on the part of the discs two effects, which will follow one another. The first effect will be that produced by the ascending vibrations, and will be an increase of pressure effected between the left-hand discs, and produced by their force of inertia augmented by that of the lead discs; the second effect will be that caused by the right-hand discs, and this will be a diminution in the pressures.

If the current of a battery, P, traverses all these discs, by the connections which we have indicated, and passes through the primary coil (by the wire, I,) of an induction bobbin, H, H' (fig. 2), placed beneath the apparatus, and if the secondary current of this bobbin passes, by the





wire, I', to the line wire, in which will be interposed a telephone or a speaking condenser, it follows that at the moment of the ascending vibrations, there will be produced an induced current in the reverse direction to that which will instantaneously succeed it, and which being reversed in consequence of the connections of the discs being crossed, will continue the action of the first current or will augment its duration, and, consequently, its power to actuate the telephonic receiver. The results of this system are very good; though Dr. Herz has tried to simplify it. Several arrangements have been tried. For example, in order to obtain the reversal, a contact has simply been placed on each side of the vibrating plate; although, as is well known, the movements of this plate are not of the same nature as ordinary sonorous movements, it was thought that they might be of the reverse kind on the two sides of the plate, and that one of the contacts would be compressed whilst the other would be expanded. This arrangement, otherwise advantageous, necessitated the plate being placed vertically, so that the same adjustment could be given to the two contacts which ought to be identical. It was difficult to regulate by weights, and even to obtain adjustment it was necessary eventually to employ two parallel diaphragms, vibrating in unison and each carrying a contact, but in opposite ways. The horizontal arrangement was reverted to; but by a convenient combination, the two principles of Dr. Herz, viz., derivation and inversion, are combined. The current is then varied by a double contact where it divides, and this contact is arranged beneath a plate, so that its two points of variable resistance act in a *reverse way as regards* each other, or only (in some apparatus) so that one of the points has no variation whilst the other acts. It is easy to understand the effect that would be produced. The system has, moreover, been experimented with under various forms; sometimes the derivation is simple, that is to say, only one of the currents is sent to line; sometimes it is double, each of the branches being furnished with a bobbin, and communicating with the receiver. In this case the result is remarkably good, but the apparatus is rather complicated; it requires, amongst other things, great care in construction, experiment having shown that the induction bobbins should not be equal, but that they should have resistances arranged according to the circuit served.

It must be added that the researches are being continued in order to determine which are the proper substances to employ as contacts for the microphones. The number of these bodies which have been tried is very large, and the important result has been arrived at, that the number of substances which can be employed is almost innumerable. The contacts in the Herz apparatus have been made with conducting substances (metal for example) reduced to powder and agglomerated, by chemical means, with a kind of non-conducting cement. The proportion of the combination of the substances depends upon the conductibility of the materials employed, and it alone determines the microphonic value of the composition; the nature of these elements appears to exercise scarcely any influence.

The speaking condenser has not been neglected, if it is useful to obviate the effects of induction. For this purpose experiments have been made to determine a convenient arrangement of the same and a regular mode of construction, the good working of this piece of apparatus being absolutely dependent upon the care with which it is set up.

According to M. Herz, the telephone should not remain an instrument which has variations in form merely; it ought, on the contrary, to be modified according to circumstances. He thinks that a telephone working to a long distance should differ from a telephone for town work only, that an apparatus made to transmit singing should not be the same as one to transmit speech; also that various types should be assigned to various purposes.—*La Lumière Electrique.*

ELECTRICAL EXHIBITION AT THE CRYSTAL PALACE.

The Lord Mayor presided, on the afternoon of the 24th October, at a meeting at the Mansion House to consider the propriety of holding an Electrical Exhibition at the Crystal Palace similar to that now being held in Paris.

Mr. McGeorge, chairman of the Crystal Palace Company, moved that the following gentlemen, with power to add to their number, be constituted an honorary council of advice:—The Lord Mayor, Mr. J. Abernethy (President Institute Civil Engineers), Professor W. Grylls Adams, Sir James Anderson, Mr. E. J. Ashby, Professor W. E. Ayrton, Lieut. Colonel T. U. Bateman-Champain, Colonel Beaumont, Mr. J. T. Bedford, Sir Henry Cole, Mr. W. Crookes, Mr. S. T. Day, Mr. Alderman Ellis (Lord Mayor Elect), Mr. H. G. Erichsen, Mr. H. C. Ford, Captain Douglas Galton, Dr. Gladstone, Colonel Gourard, Mr. W. Grantham, Mr. C. Gregory, Mr. Alderman and Sheriff Hanson, Sir J. Hawkshaw, Mr. John Holmes, M.P., Dr. J. Hopkinson, Admiral Sir

E. A. Inglefield, Professor Fleeming Jenkin, Mr. P. De Keyser, Mr. Laing, M.P., Mr. Sheriff Ogg, Sir Arthur J. Otway, M.P., Sir E. J. Reed, M.P., Mr. Samuelson, M.P., Colonel Sir Herbert Sandford, Mr. J. S. Sellon, Dr. C. W. Siemens, Mr. W. Spottiswoode (President Royal Society), Sir Henry Tyler, M.P., Mr. C. V. Walker, Mr. T. Waller, Sir E. Watkin, M.P., Mr. Pender, M.P., Mr. Hyde Clarke, and Sir John Bennett. —Mr. McGeorge stated that no guarantee fund would be required, but it was thought that from the great public interest attached to the subject, and the great public advantages likely to accrue, the City companies and the public generally might be appealed to for the purpose of providing gold medals as awards to the exhibitors. The jurors would be composed of gentlemen of the highest possible standing, who had at heart the progress of electricity.

Mr. C. Schiff, one of the Crystal Palace directors, seconded the motion, and it was carried unanimously.

Major Flood Page explained that the directors of the Crystal Palace, being anxious to do all in their power to promote technical education on the lines of the Great Exhibition of 1851, to which the Crystal Palace owes its origin, and having regard to the strong interest excited in the scientific and commercial worlds, and in the mind of the public generally, by the rapid advances recently made in the application of electricity, had decided that the second of the series of international exhibitions, inaugurated in June last by his Royal Highness the Duke of Connaught, should be an Electric Exhibition. With this view, communications had been opened with the leading exhibitors at the Electric Exhibition in Paris, and with others who have made the development of electricity their special study. Although but a very short period had elapsed since the first steps were taken, the responses had been such as to render it certain that an effective and varied display would be made at the Crystal Palace. Most of the best known systems of electric lighting would be represented; and various new lamps would be exhibited for the first time in public. The storage of electricity, would, it was hoped, be illustrated by Faure's and De Meritens' secondary batteries. Telephones, which were not nearly so much used in England as elsewhere, would be strongly represented; and the various applications of electricity as a motive power would be seen in Trouvé's boats and other interesting exhibits. Many eminent scientific men had expressed great interest in the undertaking, and intend to become exhibitors. The directors hoped, with the help of the Honorary Council, to make the forthcoming exhibition valuable to manufacturers, railway and dock companies, and others who are thinking of applying electricity to their various undertakings, and the most interesting of the kind to the general public that has ever taken place in England. It was proposed to open the Exhibition in December next, and that it should continue open for some months. Exhibitors would be received on and after 21st November. Exhibitors would not have to pay any rent, but they would, at their own expense, place and decorate their exhibits. Engine power would be found for those exhibitors of electric light who applied for it, so far as the arrangements would admit. He hoped that the Government would see their way to giving the Exhibition both their countenance and support. It was of great importance that they should do so—(hear, hear).

Mr. J. Holms, M.P., moved—"The Honorary Council having heard a report from the directors of the Crystal Palace with reference to the International Electric Exhibition—being the second of the series of international exhibitions inaugurated in June last by his Royal Highness the Duke of Connaught—cordially approves of the Electric Exhibition, believing that it will promote the development of electricity in its application to science and commerce, and will at the same time be interesting to the public." The hon. gentleman expressed his belief that the proposed exhibition would prove of great benefit to the country at large.

Colonel Gouraud seconded the proposition, and expressed the hope that, on account of England's nearer proximity to America than America to France, and also from the language of the two countries being identical, Americans would exhibit in greater numbers than at the Paris Exhibition. He said Mr. Johnson (Mr. Edison's agent) had arrived in London with a larger collection of Mr. Edison's inventions than that now shown in Paris, and would exhibit it at the proposed exhibition at Sydenham.

The proposition was supported by Captain Galton and Sir J. Anderson, and carried with unanimity.

Major Flood Page having explained that M. Cochery had promised that the French Telegraph Department will exhibit if the British Telegraph Department is also to be represented, and having also cited various cases to prove the value, of such an exhibition as that proposed, to the commercial public, on the motion of Mr. McGeorge seconded by Sir John Bennett, the Lord Mayor was thanked for the practical interest he had displayed in this and other similar movements.

The Lord Mayor expressed the pleasure it had given him to place the Mansion House at the disposal of the promoters of the exhibition. He trusted it would be a success, and he believed it would be. So far as he was concerned, any assistance in his power would be gladly given. He did not believe that the proposed exhibition, coming so soon after the Paris Exhibition, would be injured thereby. On the contrary, he believed that the Paris Exhibition had excited a public interest on the subject which would be of benefit to the one about to be held at the Crystal Palace—(hear, hear). As for Government support, he had no doubt that they would be successful in getting it. He saw no reason why the Postmaster-General, who lent his aid to the Paris Exhibition, would not do the same with regard to the one now under consideration, and he believed Mr. Fawcett would do so—(applause). He also thought that they had excellent grounds for making an appeal to the public for the means of providing gold medals, and he was satisfied that such an appeal would be successful—(applause).

The meeting then broke up.

[Having attended this meeting, we are glad to be able to state that there is every probability of the above Exhibition being a great success, and we strongly advise those of our readers who have apparatus to exhibit to apply at once for space.—Ed. *Tel. Jour.*]

Reviews.

Electric Lighting by Incandescence, and its application to interior illumination. By William Edward Sawyer. New York: D. Van Nostrand. London: E. and F. N. Spon, Charing Cross.

There is at present good reason to suppose that electric lighting by incandescence will come into very extensive use. Should the installation of the Swan system at the Savoy Theatre prove a success, as there is every likelihood of its doing, a very great impetus will be given to the future development of the method of lighting. Edison is undoubtedly the pioneer of a successful incandescence system, although to Mr. Swan belongs the credit of having

originated the "incandescent carbon loop," which is employed in some form or other in almost every lamp of the kind yet devised. The fact that Swan, some 20 years ago, devised an incandescence lamp with a thin carbon loop is now very generally known, although Mr. Sawyer, in the historical summary in his book, does not mention it; this however may have been due to inadvertence, as the work in question is practically a description of the systems and principles with which Mr. Sawyer is acquainted. To do Mr. Sawyer justice, he certainly has endeavoured to give full information on the subject, and, moreover (as he states in the preface), he has sought less to indicate defects, than to exhibit accomplishments. The first three chapters in Mr. Sawyer's book are devoted to short descriptions of the various dynamo machines now generally known; amongst others, a machine invented by the author is explained; the principle of this apparatus is that of changing the magnetic power of the soft iron core in a bobbin by bringing a large mass of soft iron near the core, the currents, in fact, are generated in the machine by the rotation of a soft iron wheel with projecting spokes, the bobbins remaining stationary; this machine is, however, stated not to be particularly effective. A modification by the author of the Siemens' machine is also described: its principal object is to reduce the heating which takes place in the ordinary form of machine; this is effected by keeping water circulating in the armature, a device which experiments proved to be quite efficacious.

The chapter on "Carbons for incandescent lighting" contains much useful information on the subject; the whole question of carbons generally, is of such great importance that it requires much more attention than has yet been paid to it. To obtain really good carbons for arc lighting, the manufacture requires, we consider, to be as perfect as for the finest porcelain, indeed it is a subject which porcelain manufacturers might turn their attention to with great advantage.

Mr. Sawyer, in describing his own incandescent lamps, naturally does so at a considerable length; but although various modifications of the same have been made, the latest or "perfected" form does not seem altogether to be a very happy idea, more especially when it comes to be compared with the far simpler inventions of Edison and Swan; no doubt, however, it would work well.

The chapter on the "Division of current and light" is of a rather elementary character, although what information there is, is dealt with in a practical manner. The concluding chapters have reference to "Regulators and Switches," "General Distribution," and "Commercial Aspects," the latter being from an American point of view, *i.e.*, in making comparisons American prices are taken.

Although no doubt there is a considerable amount of information in the work, one of its principal objects is undoubtedly to bring out the Sawyer system as prominently as possible.

Johnston's Illustrations of the Electro-Deposition of Metals. By W. & A. K. Johnston. Edinburgh and London.

These diagrams, which form part of the series dealing with electrical science, are very suitable for class instruction, being distinctly and boldly drawn and coloured. The small explanatory handbook, which is written by Mr. Alexander Watt, is well suited for its purpose.

English-French Technical Vocabulary, for Scientific, Technical, and Industrial Students. By Dr. F. J. Wershoven. Libraire Hachette & Cie., 18, King William Street, Strand, London.

The title of this book explains its contents. It is a most useful work, and no one who is engaged in making translations of, or reading, French scientific works should be without it. It has well supplied a real want.

Correspondence.

CITY AND GUILDS OF LONDON INSTITUTE EXAMINATIONS.

To the Editor of The Telegraphic Journal.

Sir,—I was glad to read the letters from "A Student" and "W. M. M." which have recently appeared in your Journal. As a teacher under the City Guilds, I can endorse much that has been stated on the subject of the recent examinations which have proved so discouraging both to pupils and teachers; as a consequence many are deterred from joining the classes, knowing the odds against them.

During last session I taught a class (under the Science and Art Department) consisting of students, strangers to the subject, but succeeded in passing 95 per cent. 1st class.

During the same session I taught one under the City Guilds, in a branch of industry in which the students had all served some years and all were possessed of a good education; in spite of this, only about "25 per cent." succeeded in taking 2nd class elementary certificates. In consequence of this, they and others are deterred from any further attempt, and the class falls through. If *all* the pupils succeeded in passing, the remuneration to teachers is small, seeing the classes are limited to those actually engaged in the industry to which the examination refers. But, when the successes are so small as at present, owing to the high standard required, I would ask where is the remuneration for seven months' work to come from?

I agree with "W. M. M." that the practice of giving ten questions and expecting all to be answered is too much for three hours, and especially when some of the questions are not on subjects included in the syllabus, which at best is a very vague guide for the teacher. I would ask with "A Student" why the syllabus is not arranged to suit each grade, the same as that issued by the Science and Art Department?

Yours truly,

A TEACHER.

[A subscriber, who gives no name or address, writes to us with reference to the latest form of the "Brush Dynamo Machine." We are informed that the apparatus has undergone no essential change since the time when we published an account of it in the Journal. (See Telegraphic Journal, Jan. 15th, 1879).—Ed. Tel. Jour.]

Notes.

TO OUR READERS.

: of the extreme pressure on our space, decided to issue, on Saturday, the 5th an extra supplemental number of THE IIC JOURNAL. This issue will consist otices of British and foreign exhibits at :al Exhibition now being held at Paris, ık will prove of considerable value to our of whom, almost without exception, are ss directly interested in those exhibits. will receive this extra number by post

RAL CRYSTALS WITH INCLINED PLANES AS SOURCES OF ELECTRICITY.—By MM. Pierre Curie.—A section suitably cut from al crystal with inclined planes, and laid › leaves of tin forms a condenser which ırged spontaneously on compression. In a new instrument may be obtained, that is, · having special properties. These prow from the laws which we have formerly for the liberation of electricity in hemiıls. We will now show how this instrument ıs a standard of static electricity for the t of charges or capacities. We shall also solute measurement of the quantities of sengaged by tourmaline and quartz at a re.

sary to call to mind three of the fundaperties which are possessed by a crystal condenser-source: 1, the two planes are ı quantities of electricity exactly equal and signs; 2, when one of the phases is in ion with the earth the other furnishes a :ity of electricity for a given pressure; ity of electricity evolved and the pressure proportional.

se propositions it follows that whilst a oles us to bring a conductor to a given condenser-source will furnish a conductor minate quantity of electricity; further, this y be selected beforehand above a certain

tity of electricity developed by a weight of d upon a tourmaline is capable of raising 14.2 c.m. to the potential of 1 Daniell. ty of electricity disengaged by 1 kilo. ate of quartz perpendicular to a horiis capable of raising a sphere of o the potential of one Daniell. These easure what may be called the electric e pressure of tourmaline and quartz. The asures have been made with the aid of an which applied the pressure directly to the ıt when it is desired to employ the crystal of electricity it is more convenient to apply : by means of a lever, keeping it all the :y enclosure. It is better not to be conıt the arms of the lever, and to determine e for all, the quantity of electricity liberated of 1 kilo. placed at the end of the lever. tal is never displaced it may serve as a

wing method will serve in all cases for quantity of electricity set free: the needle on-Mascart electrometer being charged by means of a battery, one of the tin-foils of the crystal is connected with the earth, and the other with one of the couples of sections of the electrometer, and at the same time with a conductor of known capacity. This totality of conductors being insulated, the other couple of sections of the electrometer are placed in communication with one of the poles of a Daniell's element, the other pole being connected with the ground. The needle of the electrometer deviates, and weights acting upon the crystal are added until the needle is brought back to zero. This operation is conducted like an ordinary weighing, by adding or removing weights, the quantity of electricity disengaged depending only on the final pressure.

The tin-foil of the conductor-source, the standard of capacity, and the sectors of the electrometer are then at the potential of 1 Daniell, and the weight which is required for this purpose is known. The same operation is repeated after having suppressed the standard of capacity. The difference of the weights obtained in the first and second case represents the weight necessary to raise the standard of capacity to 1 Daniell.

The method which we are about to describe includes in itself a process for the comparison of capacities. We may, in fact, determine by means of three weighings, the quantities of electricity needful for raising two conductors to the same potential, whence the ratio of their capacities may be inferred.

On the contrary, by charging the two sectors with two different elements, and finding the weights necessary for bringing one and the same capacity to the same potential, we have the ratio of the electrometer forces of the two elements.

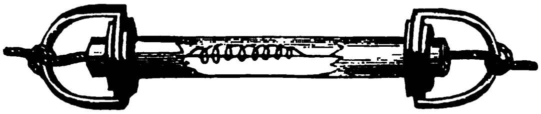
Finally, we may measure a charge with great precision, the body charged being placed in connection with the condenser-source, and with any electrometer, the latter shows the presence of electricity, and is brought back to zero by placing weights upon the condenser.

These methods have the advantage of always bringing back the electrometer to zero. It serves. therefore, merely as an electroscope, and a greater sensitiveness may be employed. The determination of capacities and that of charges is effected thus with precision. The apparatus may also serve for maintaining at the same potential a body which constantly loses electricity, and which must remain insulated.

The constants of a condenser-source are: 1, the quantity of electricity disengaged by a weight of 1 kilo. at the end of the lever; 2, its capacity. To charge bodies of very small capacity, it is advantageous to have a condenser-source of very feeble capacity; a tourmaline or quartz of 0.01 metre in height, and of a few square millimetres of surface cannot reach the capacity of a sphere of 0.01 metre radius and furnish quantities of electricity capable of charging a sphere of 3 metres radius to the potential of 1 Daniell. To charge bodies of a rather greater capacity, there is no great inconvenience in augmenting the capacity of the condenser-source, and it may be obtained by making the quantities of electricity much more considerable. We have constructed a battery of 9 plates of quartz, cut parallel to each other, and perpendicular to a horizontal axis in one and the same specimen of homogeneous quartz. Each plate has about 20 square centimetres of surface. They are placed one upon another, separated by sheets of tin-foil, all those of even numbers being folded back. It results from this arrangement, that on a variation of pressure exerted upon the pile, all the tin-foils of the even numbers are charged with one electricity, whilst those of uneven numbers are charged with the other. By connecting

on the one hand all the tin-foils of the even numbers, and on the other hand all those of the uneven, we have a condenser-source, the capacity of which is that of a sphere of 3.5 metres radius. It easily furnishes wherewithal to charge $\frac{1}{10}$ microfarad to the potential of a Daniell.—*Comptes Rendus.*

Moore's Double Swivelled Disconnecting Electric Wire Tube.—The object of this invention is the attachment of telegraph wires to swivels, and to allow of the cables revolving without cutting off electric communication. The cables, made smooth where they enter, are fastened to the swivels in any manner desired, and then passed through a stuffing box at the shoulder end of the tubes. On leaving the stuffing boxes and entering the tubes, the cables are stripped of their outer coating. One wire is made spiral and the other



straight, the latter revolving inside of the former, both wires being detached when in the tube. These swivelled tubes may be applied to cables on board of, or suspended from, vessels; or to cables on the bottom of rivers or seas. By the tubes turning with winds or tides they prevent cables from kinking, and also lessen the strain on the wires. The tubes may also be applied to disconnect land wires underground or overhead.

Telegraphic Communication with Lighthouses.—The Lord Mayor presided on the 19 ult. at a meeting in the Mansion House to consider the need of establishing telegraphic communication between lighthouses and light-ships and the shores, with a view to prevent as much as possible loss of life from shipwrecks on the coasts of the United Kingdom. The attendance was not very large.

The Lord Mayor, in opening the proceedings, said he had great pleasure in granting the use of the Egyptian Hall for such a meeting as this. A requisition had been addressed to him signed by, he thought, 1204 gentlemen, requesting him to call a meeting for the purpose of promoting as far as possible telegraphic communication between lighthouses and lightships and the shore. Considering that this was a matter not of local interest alone, but of national interest and importance, he felt bound to do his utmost to forward the object of the meeting. Now that we had telegraphic communication all over the country, and indeed over all parts of the world, it was only fair and right that those who were obliged to spend much of their time in lighthouses on our coasts should have opportunities of having communication with the shore. A great many of the lightships and lighthouses around our coasts were built near quicksands or were built on rocks, and some of them were as far away from the shore as ten, twelve, and fifteen miles. He could conceive nothing more uncomfortable than the position of the watchers in those places without any proper means of communication between themselves and the shore. Guns and rockets answered, perhaps, well enough in fine weather, but they were of little or no use in snowstorms, and during such gales as that which prevailed last Friday. He believed telegraphic communication with those places and the land would be the means of saving not alone a large amount of property, but many valuable lives during every year. The object of the meeting was to provide such a means of communication. To that end it was proposed that the Government should be asked to establish telegraphic communication between our lightships and lighthouses and the shore. The Government might take up—and ought to take up—such a matter as this. The question for the consideration of which the meeting had been called was one of national importance. He hoped, therefore, that the Government would see their way to take up the matter and comply with the request of the meeting—(hear, and applause).

Mr. J. Hobbs, the principal promoter of the meeting, moved:—"That, in the opinion of this meeting, it is a matter of urgent necessity that electric communication should be established between the various lighthouses, light vessels, and the shore, in order that more speedy intimations of vessels wrecked and life and property in peril may be afforded to those ready to come to the rescue."

Mr. A. Shippey, the inventor of the signal balloon, seconded the proposition, and it was carried with unanimity.

Mr. W. H. Lefevre moved a resolution requesting the Lord Mayor to forward the resolutions of the meeting to Mr. Gladstone, with a prayer that the Government should take some immediate practical steps to carry out and to effect such requisite communication, and that the result of such requisition be published.

Mr. G. Nelson (Margate), seconded the motion, which was also carried unanimously.

A vote of thanks to the Lord Mayor concluded the proceedings.

The Electric Light and Power Generator Company, Limited.—An extraordinary general meeting of the members of the Electric Light and Power Generator Company (at which Admiral Sir E. A. Inglefield presided) was held, on October 26th, at the Cannon Street Hotel, for the purpose of considering certain agreements which had been provisionally entered into respecting the purchase of the Maxim Incandescent Light. The price to be paid for it was £54,000, of which £12,500 could be paid in shares. This included all rights in India, America, and the British Colonies, with the exception of Canada. The motion, having been adopted, the chairman invited the shareholders to inspect the Maxim lamp at its present stage of development.

The Paris Electrical Exhibition.—Sir Charles T. Bright writes to the London papers that he is informed officially that this Exhibition will close on November the 17th.

A Long Span.—The longest span of telegraph wire in the world is stretched across the Kistnah River from hill to hill, each hill being 1,200 feet high, between Bezorah and Sectanagrum, in India. The span is a little over 6,000 feet in length. The only mechanical contrivance used in stretching this cable across the river was a common windlass.

The Orkney and Shetland Telegraph Cable.—The *Dacia*, which has now been engaged for some weeks in the work of getting up old telegraph cables lying submerged between Orkney and Shetland, has returned to Shetland, after successfully recovering the second cable. The weather, however, is so stormy that it may be a considerable time before anything can be done towards submerging the new cable. On a former occasion a steamer lay for months in the islands without a single day on which these stormy seas could be got over and a cable laid, and the Shetlanders are now afraid that a similar thing may occur.

The Jersey Cable.—The cable between Dartmouth and Jersey is interrupted. The fault is believed to be close to Dartmouth.

THE ELECTRIC LIGHT IN WESTMINSTER.—The *Westminster and Chelsea News* says that the Westminster District Board of Works have resolved to obtain tenders from the Electric Lighting Companies to ascertain the cost of lighting Parliament Street, the Broad Sanctuary, and Victoria Street, by this system of lighting.

ELECTRIC LIGHTING IN RAILWAY TRAINS.—The first application of electricity to the lighting of railway carriages has been made in one of the Pullman cars on the London and Brighton Railway. The car was filled with eight of Swan's incandescent lamps, which were supplied with electricity from one of Faure's accumulators. The trial was perfectly successful, the clearness and steadiness of the light being quite unaffected by the motion of the train.

CONSTANT GALVANIC ACTION.—Prof. Exner, of Vienna, has lately proved that galvanic elements formed of three elementary substances, one of which is bromine or iodine, give perfectly constant action, and that the electromotive forces exactly correspond to the heat values of the chemical processes. There is no trace of polarisation. Bromine and iodine are also shown to be the worst conductors of electricity at present known. Both bromine and iodine conduct entirely without polarisation (the latter in solid as well as in liquid condition). The conductivity rises rapidly with the temperature.—*Nature.*

CHESTERFIELD AND THE ELECTRIC LIGHT.—Chesterfield, which at night for some weeks has been in a state of total darkness, has decided to light up with the Brush electric light. It is calculated that the large town can be lighted by 34 2,000 candle-power Brush lights, which cover the ground at present occupied by 170 gas lamps, the remainder of the lighting to be done by 36 "Orion" lamps. The capital expenditure for dynamo machines, lamps, driving power, &c., comes to £2,700, and the annual cost of running the same is set down at £550, which includes all the working expenses, the only additional annual charge being that in respect of interest and depreciation, which is set down by the Chesterfield authorities at £250.

THE OXY-HYDROGEN LIGHT BY ELECTRICITY.—Professor Blyth, in the course of some remarks made at the opening of the evening science lectures at Anderson's College, Glasgow, said: "The electric light had so dazzled our eyes and filled our heads that there seemed to be little room left for seeing or considering other methods of converting mechanical work into heat and light through the agency of the electrical current. One such method in particular had been very strangely ignored—the method of lighting by the oxy-hydrogen light, where the gases are supplied by electrolysis. There seems to be no reason why our waterfalls and sources of power should not be used to fill gasometers with the separate or mixed gases oxygen and hydrogen, and then these led, like ordinary gas, to produce the brilliant oxy-hydrogen lime-light, or in some cases to produce for useful purposes the intensely hot oxy-hydrogen flame. Lighting by this method did not labour under the great disadvantage of being difficult to subdivide, and from some rough calculations which he had made, he considered that when the source of power was running to waste at any rate, it would be economical."

GLASGOW AND THE ELECTRIC LIGHT.—At a meeting of the Glasgow Town Council, held on the 5th inst., a proposal to apply to Parliament to "vest the corporation with the exclusive right and privilege of manufacturing and supplying electric light to the inhabitants of the city and suburbs," and in connection with this, to modify the stipulation in the Gas Act as to the illuminating standard of gas, was carried by 28, as against 6 votes for an amendment for delay.

THE ELECTRIC LIGHT IN THE PARIS OPERA HOUSE.—A gala performance has been recently given at the Paris Opera House, with the co-operation of all the eminent electricians now in Paris, in order to test various methods of applying the electric light to the building. The President of the Republic and all the Ministers of State were present, as well as a large number of distinguished visitors. The experiment was incomplete, as the arrangements for the whole building could not be finished in time. Seventy-two Jablochkoff centres were placed below the ceiling round the upper frieze. The steam engines and the electric generators are placed in the opera vaults. The conductors are inclosed in a double lead envelope to guard against any accident that may occur from breakage of the wires and from the high temperature that may be induced by excessive tension. At a second experiment of the electric lighting it was anticipated that the whole house would be lighted by electricity, and much disappointment was therefore expressed at finding gaslight everywhere. The staircase, auditorium, and *foyer* were all more or less lighted in the customary way, the Brush, Swan, and Edison electric lights being but partially employed. The only parts exclusively lighted by the new method were the small saloons at the end of the *foyer*. Not a few visitors expressed themselves decidedly against the electrical system. The light was stated to have an unfavourable effect upon the gilt decorations and bronze work of the house, and it caused the projections to throw shadows of an unsightly length.

THE ELECTRIC LIGHT IN ITALY.—The *Perseveranza*, of Milan, says:—"The President of our Chamber of Commerce has requested Mr. James Shepherd, during his visit to Paris to the Electrical Exhibition, to study, in name of the Chamber, the new applications of the electric light to industries, persuaded that the observations of Mr. Shepherd, whose knowledge in this science is well known, will be to the great advantage of our industries. We feel sure that Mr. Shepherd will fulfil in every way this charge." Mr. Shepherd has also been specially delegated by the Societa d'Incoraggiamento per le Arti e Mestieri, of Milan, to obtain the necessary material (machines and lamps) for a new series of lectures on the electric light, to be held next winter.

New Patents—1881.

4234. "Treatment of india-rubber and of products made therefrom" (coating wire with india-rubber). H. J. HADDAN. (Communicated by U. Kreusler and E. Budde.) Dated September 30. *Complete.*

4420. "Improvements relating to telephone and telegraphic apparatus and circuits." S. PITT. (Communicated by W. R. Patterson and C. C. Scribner.) Dated October 11. *Complete.*

4421. "Apparatus for use upon telephone wires." G. PITT. (Communicated by E. C. Buell.) Dated October 11. *Complete.*

4428. "Telephonic apparatus." A. R. BENNETT. Dated October 11.

4439. "Incandescent electric lamps." J. JAMESON. Dated October 12.

4448. "Electro-magnets for telephonic and other purposes. J. IMRAY. (Communicated by J. Milton Stearns.) Dated October 12.

4450. "An improved method and apparatus for effecting telephonic communications." J. IMRAY. (Communicated by J. Milton Stearns.) Dated Oct. 12.

4454. "Improvements in instruments for measuring electric currents partly applicable to thermometric regulators." J. T. SPRAGUE. Dated October 12.

4455. "Construction of secondary batteries, or apparatus for effecting electrical storage." J. W. SWAN. Dated October 13.

4472. "A new or improved electric meter or apparatus for measuring and registering the quantity of electricity passed through a conductor." C. V. BOYS. Dated October 13.

4473. "Pneumatic signalling apparatus for railway trains." C. D. ABEL. (Communicated by P. Rimacheosky and W. Tagaitschinoff.) Dated October 13.

4478. "Electric lamps." R. HARRISON. Dated October 14.

4496. "Regulators for electric-motors." J. H. JOHNSON. (Communicated by La Société Anonyme, la Force et la Lumière Société Générale d'Electricité.) Dated October 15.

4504. "Electric arc lamps." J. BROCKIE. Dated October 15.

4507. "Insulators for telegraph and other wires." A. E. GILBERT. Dated October 15.

4508. "Improvements in or connected with apparatus or means for the production, collection, or storage and distribution of electricity, parts of which improvements are also applicable to other similar purposes." J. H. JOHNSON. (Communicated by E. H. Parod.) Dated October 15.

4518. "Apparatus for driving or operating sewing machines by electricity." H. H. LAKE. (Communicated by J. J. Journeaux.) Dated October 17.

4533. "Electric lamps." R. R. GIBBS. Dated October 18.

4541. "Improvements in the generation, collection, and distribution of electro-magnetic currents, and in the apparatus employed therein." R. KENNEDY. Dated October 18.

4544. "Manufacture, treatment and application to various purposes of hyponitric, anhydride and apparatus therefor. (Lights for optical telegraphs, &c.) E. TURPIN. Dated October 18. *Complete.*

4552. "Dynamo or magneto-electric machines." P. JENSEN. (Communicated by T. A. Edison.) Dated October 18.

4553. "Method and means for charging and using secondary batteries." P. JENSEN. (Communicated by T. A. Edison.) Dated October 18.

4559. "Apparatus for generating and utilising electricity." T. M. NEWTON. Dated October 19.

4571. "Measurement of electricity in distribution systems." E. G. BREWER. (Communicated by T. A. Edison). Dated October 19.

4576. "Meters for measuring electric currents." E. G. BREWER. (Communicated by T. A. Edison.) Dated October 19.

4582. "Improved means of supplying electricity for lighting purposes in railway and other carriages and steam-boats." A. M. CLARK. (Communicated by J. *de Changy née de Deyn.*) Dated October 19.

4591. "Mode of generating electricity." H. J. HADDAN. (Communicated by G. Dessaigne.) Dated October 20.

4592. "Improvements in apparatus for generating electricity, and for the production of electromotive power, parts of which improvements are applicable to other purposes." A. MILLAR. Dated October 20.

4607. "Magneto-electric machines." H. F. JOEL. Dated October 21.

4617. "Electric lamps." A. M. CLARK. (Communicated by H. B. Sheridan.) Dated October 21. *Complete.*

4632. "Construction of secondary batteries." J. STELLON. Dated October 22.

4641. "Improvements in targets and in electrical indicating apparatus chiefly designed to be used in connection therewith." W. R. LAKE. (Communicated by A. Boivin.) Dated October 22.

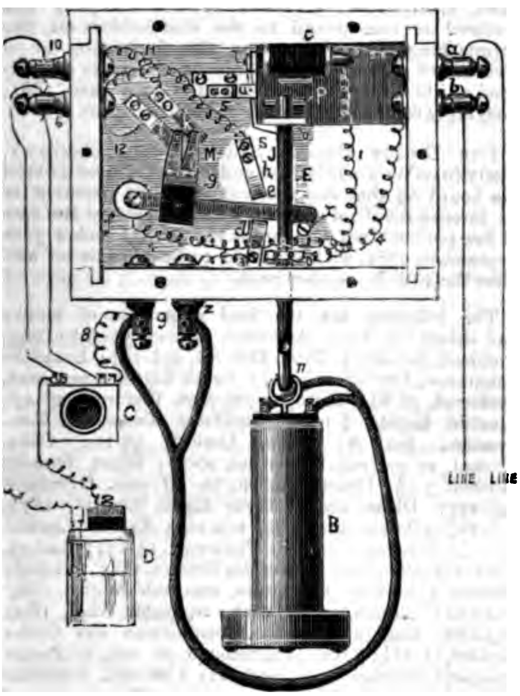
4654. "Electric incandescent lamps." G. G. ANDRE. Dated October 17.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1881.

417. "Railway signalling apparatus." JOHN NEVIL MASKELYNE. Dated Jan. 31. 2d. The object of this invention is to provide simple and efficient means for working the distance and other signals on railways, whereby the stretching and contracting of the wires or rods used for that purpose (whether such variations in the length of the wires or rods be due to atmospheric changes or to other causes) will be compensated for. (Void by reason of the patentee having neglected to file a specification in pursuance of the conditions of the letters patent.)

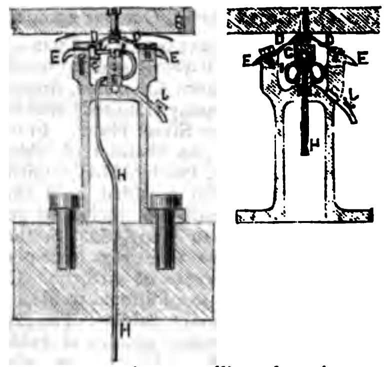
663. "Telephonic apparatus," &c. P. M. JUSTICE. (A communication from abroad by Homer Rice Miller, of America). Dated Feb. 16. 1s. Relates to electric speaking telephones and to signalling mechanisms adapted to be used therewith. The first includes locking mechanisms whereby the operator at any given station may lock out all the stations in the line excepting his own and that with which he desires to communicate. The second part includes an improved electric signal specially designed to be used in connection with electric speaking telephones, but also capable of independent use. The first part of the invention is shown by the figure. In this arrangement the circuit of the transmitter battery is made or broken by the movement of the prongs, *i*, caused by the movement of the switch lever, *e*, which action is necessary when the ordinary Leclanché or a like battery is used with the transmitter. The free end of the lever, *e*, extends through a slot (indicated in dotted lines) in a vertical rod, E. This rod has a hook on the lower end, on which is hinged the telephone (B), and passes through guides, O, O, fixed to the frame. The rod is supported upon a spring, *p*, which rests on the upper guide piece, O, and bears underneath a pin in the end of the rod. The slot in the rod, E, is wider than the switch bar, and allows the spring, *p*, to lift the rod slightly without moving the lever. The tension of the spring is such that the weight of the telephone, B, will depress the rod so as to bring the notch, J, in said rod opposite the end of a bent lever, S, the end of which is fitted to engage with the notch and lock the rod so that it cannot be pushed up. The armature of the magnet, *t*, is attached to the upper end of the bent lever, S, the lever being so pivoted upon the arm in the case, that the armature when drawn up shall throw the lower end of the lever out of connection with the notch, but when not drawn up, the armature shall fall back by gravity and throw the end of S into connection and lock the rod so that it cannot be

ised. It will be understood from this description of e parts that the magnet, *c*, at every station in the ie is in the main line circuit. Under ordinary con-tions of the circuit, and when no telephones are itched in, the effect of a current is to keep the arma-re, *t*, drawn up and the rod unlocked. But when an erator at any given station is called, he unhooks and unts in his telephone. The great resistance of the lephone then brought into the line so weakens the rrent that it will no longer act upon the electro-agnet, *c*, sufficiently to draw up the armature, and ese armatures in the whole circuit of the line will erefore fall back by their own gravity and lock all the ds through which the shunting devices are operated, cepting that from which the telephone has been moved. This happens of course at the station



hich has been called, where the operator, having moved the telephone, the rod, E, is lifted by the ring, *p*, sufficiently to raise the notch above the tch without disturbing the shunting lever, *e*, as that oves in the slot. The operator at this station may ash up the rod, E, and shunt in his telephone, and is ius able to communicate with another station without ability of interruption by the operator at any other ation, or that the communication will be heard except the two stations in connection. By pushing up the d, E, the shunting lever, *e*, is lifted so that it leaves ie point, *d*, and is moved upon the point, *h*, on which is held by friction. At the same time the points of ie plate are shifted so as to inclose the points, and *k*. This movement of the lever from *d* to *h* unts in the telephone, and that of plate, *i*, closes the ircuit of the local battery.

783. "Electrical conductors." J. PERRY and W. E. YRTON. Dated Feb. 24. 8d. The invention is designed r the better and more convenient insulation of the lectric conductor for the transmission of power in lectric railways, and for furnishing an automatic block ystem without the use of signalmen, and further by hat method of insulation to give an easy and simple indication of the position of a train or carriage at any point of its travel, or simultaneously of any number of trains or carriages, and thus to furnish a simple means of electric warning throughout the line. For this purpose the insulated conductor conveying the current is divided into sections fairly well insulated from one another and from the earth, so that leakage to the earth of the current which propels the train can only take place from that section or sections of the rail which are at any moment electrically connected with the continuous insulated conductor. In figs. 1 and 2.



A B is a copper or other metallic rod resting on the top of and fastened to a corrugated tempered steel disc, D, D, which is carried by and fastened to a thick ring, E, E, made of insulating material, either by a metal ring or by six screws and washers. The insulating ring is itself screwed to the top of the circular cast-iron box which latter is fastened to the ordinary sleepers by wooden or iron pins or screws. The rail, A, B, and the corrugated steel discs, D, D, have sufficient flexibility that two or more of the latter are simultaneously de-pressed by an insulated collecting brush or roller, carried on one or all of the carriages composing the train, or on the single carriage if there be not more than one. Depressing any one of the corrugated steel discs brings the stud, E, which is mechanically and electrically con-nected with the rod or rail, A, B, into contact with the stud, G, which is electrically connected with the main insulated cable previously referred to, or with one of them if there be more than one. This connection is made either by means of a gutta-percha or other in-sulated wire, H, H, H, or by H, H, being the main cable itself brought up into the box. To prolong the contact the stud, G, is supported by a spiral spring, as shown in the drawing, so as to be depressed somewhat by F. In the neighbourhood of a train the rail, A, B, is then electrically connected with the well insulated cable or conductor at two or more points or contact boxes, and the train receives electric power through the brushes or rollers under the carriages or under some of them, and the current after passing through a suitable electro-motor on one or all of the carriages, returns by means of one or both of the ordinary uninsulated rails of the line, good electric contact between the successive pieces of rail forming the ordinary permanent way and used as the return wire, being insured by pieces of flexible wire being attached if necessary in addition to the ordinary fish plates.

803. "Dynamic apparatus and motors, &c." RICHARD WALLER. Dated Feb. 25. 10d. The im-provements in batteries consist in giving a rotary motion to plates of zinc or copper, zinc or graphite, or any suitable materials, immersed in any of the well-known fluids used in batteries. The improvements in motors consist in placing the armature between two magnets, as usual, but instead of being equidistant

from the poles, it is placed so that it is always in contact with one limb of each of the magnets, between which it has an alternate or reciprocating motion, the upper end being at a distance from these magnets regulated by the length of stroke it is desired to obtain.

City Notes.

Old Broad Street, October 25th, 1881.

EASTERN EXTENSION, AUSTRALASIA, AND CHINA TELEGRAPH COMPANY.—The half-yearly general meeting of the shareholders of the Eastern Extension, Australasia, and China Telegraph Company (Limited) was held on October 19th, at the Cannon Street Hotel. In moving the adoption of the report, an abstract of which has been already published, Mr. Pender, M.P., chairman of the board of directors, who presided, said that the gross receipts during the half-year including government subsidies amounted to £191,580. In the corresponding period in 1880 the gross receipts were £173,020, showing an increase of £18,560. Of this increase £9,820 was owing to additional traffic, and the balance represented additional subsidies. The expenses during the half-year, including repairs of cables and expenses of ships as well as income tax, absorbed £55,230 against £50,384 for the corresponding half-year, showing an increase of £4,846, which was caused by the additional expense requisite for renewals of cables and the maintenance of ships, by additional income tax, and by contributions to the staff insurance company. From the balance of £136,350 had to be deducted £41,595 for interest on debentures and contributions to sinking funds, for redemption of the Australian Government subsidy and Manilla debentures, leaving £94,755 as the net profit for the half-year, as against £95,535 for the corresponding period. This was a decrease of £780. Out of the half-yearly revenue, however, £13,295 had been set aside for the redemption of the Australian Government subsidy and the Manilla debentures, and £2,500 for interest on the Manilla debentures. Only for these special charges, the net revenue would have been at least £14,000 more than it had been. An interim dividend had been already declared of 1½ per cent. It was now proposed to distribute another dividend of the same amount, together with a bonus of 1s. per share, payable that day. This would make a total dividend of 3 per cent. for the half-year, after paying which they would carry forward £34,830. There was one paragraph in the report to which he desired to draw special attention. He alluded to the one informing the shareholders that the Singapore-Batavia cable had for some time past been a source of anxiety, owing to the increasingly numerous and costly repairs which had been necessary to maintain the line in working order. The directors had decided to replace it with a brass ribboned cable, 580 miles in length, designed to resist the attacks of a marine insect called the teredo, which had been very destructive to the old line. The chairman produced some of the cable after its interior had been scooped out and rendered positively useless by the insect referred to. A satisfactory arrangement had been entered into with the Telegraph Construction Company to carry out the work and pick up existing cable for £95,000, which it was proposed to pay out of revenue by instalments. It was hoped that by this means a large annual saving would be effected on the cost of repairs, and that by the arrangement made for payment of the new cable the dividend to the shareholders would not be interfered with. From £7,000 to £10,000 had been lost during the past three years by the ravages of this little insect. He hoped that when next he met them—six months hence—to be able to report that the new cable was laid, and that the old one had been taken up and repaired in such a way as to render it proof against the ravages of the teredo. It was with much regret that the directors had to report the death of their colleague, Colonel Glover, who had been in the service of the company since its formation, and who was generally esteemed and prized. Mr. W. N. Massey, M.P., vice-chairman, seconded the motion for the adoption of the report, and it was agreed to unanimously. A vote of regret at the loss of Colonel Glover and sympathy with his widow and family, proposed and seconded by shareholders, concluded the proceedings.

THE WEST INDIA AND PANAMA TELEGRAPH COMPANY, LIMITED.—The board of this company has resolved to recommend to the shareholders at the approaching general meeting the declaration of a dividend of 3s. per share on account of arrears of dividend on the first preference shares to 30th June, 1881, carrying £8,708 8s. 2d. to the current half-year.

THE DIRECT UNITED STATES CABLE COMPANY, LIMITED.—We are informed under date October 21 that the board on that day resolved upon the payment of an interim dividend of 5s. per share, being at the rate of five per cent. per annum for the quarter ended 30th September, 1881, such dividend to be payable on and after the 16th November next.

The following are the final quotations of stocks and shares:—Anglo-American, Limited, 52-52¼; Ditto, Preferred, 80½-81½; Ditto, Deferred, 23¼-23¾; Brazilian Submarine, Limited, 11⅛-11⅜; Brush Light, 4 per cent. Preferred, 7¾-8¼; Ditto, 10 per cent. Preferred, 16-17; Electric Light, ¾-1; Consolidated Telephone Construction, ¾-1 A; Cuba, Limited, 9½-10; Cuba, Limited, 10 per cent. Preference, 16-17; Direct Spanish Limited, 5-5½; Direct Spanish, 10 per cent. Preference, 14½-15½; Direct United States Cable, Limited, 1877, 10⅛-10⅜; Debentures, 1884, 100-103; Eastern Limited, 10-10¼; Eastern 6 per cent. Preference, 13-13¼; Eastern, 6 per cent. Debentures, repayable October, 1883, 100-103; Eastern 5 per cent. Debentures, repayable August, 1887, 101-104; Eastern, 5 per cent., repayable Aug., 1899, 105-108; Eastern Extension, Australasian and China, Limited, 11-11¼; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 108-111; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 102-105; Ditto, registered, repayable 1900, 102-105; Ditto, 5 per cent. Debenture, 1890, 102-105; Eastern and South African, Limited, 5 per cent. Mortgage Debentures, redeemable 1900, 102-105; Ditto, ditto, to bearer, 102-105; German Union Telegraph and Trust, 10-10½; Globe Telegraph and Trust, Limited, 6¼-6¾; Globe, 6 per cent. Preference, 12¼-12¾; Great Northern, 11¾-12¼; 5 per cent. Debentures, 103-105; India Rubber Company, 28-29; Ditto, 6 per cent. Debenture, 103-105; Indo-European, Limited, 28-29; London Platino-Brazilian, Limited, 4¾-5¼; Mediterranean Extension, Limited, 2½-3; Mediterranean Extension, 8 per cent. Preference, 9½-10; Oriental Telephone, ⅜-½; Reuter's Limited, 11½-12½; Submarine, 290-300; Submarine Scrip, 2⅛-2⅜; Submarine Cables Trust, 97-100; United Telephone, ——; West Coast of America, Limited, 4¼-4¾; West India and Panama, Limited, 1¾-2; Ditto, 6 per cent. First Preference, 7¼-7¾; Ditto, ditto, Second Preference, 6-6½; Western and Brazilian, Limited, 6¾-7¼; Ditto, 6 per cent. Debentures "A," 110-115; Ditto, ditto, ditto, "B," 99-103; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 125-130; Ditto, 6 per cent. Sterling Bonds, 104-107; Telegraph Construction and Maintenance, Limited, 26-27; Ditto, 6 per cent. Bonds, 104-108; Ditto, Second Bonus Trust Certificates, 1⅛-1⅜.

[E]XPOSITION INTERNATIONALE D'ÉLECTRICITÉ.

PARIS, 1881.

LIST OF AWARDS.

(Reprinted in Full from the Official List.)

[GRA]NDS DIPLOMES D'HONNEUR.

France.

[Minist]ère des postes et télégraphes.

Allemagne.

[Reichs]-Postamt.

Angleterre.

[Admin]istration des télégraphes de la [Gran]de-Bretagne (Post Office).

Autriche.

[Minist]ère I. R. du commerce (Administration des télégraphes).

Belgique.

[Admin]istration des télégraphes de [l'Eta]t.

[DI]PLOMES D'HONNEUR.

[DÉCER]NÉS AUX MINISTÈRES, AUX [ADMI]NISTRATIONS AUX SOCIÉTÉS [SAVA]NTES ET AUX COMPAGNIES DE CHEMINS DE FER.

France.

[Ministè]re de l'agriculture et du com[merc]e (Conservatoire national des [arts e]t métiers.
[Ministè]re de la guerre.
[Ministè]re de la marine et des colonies.
[Ministè]re de l'instruction publique et [des] beaux-arts (Bureau central [méte]orologique.—Observatoire de [Mars]eille et Observatoire de Paris.)
[Ministè]re des travaux publics (Service [centr]al des phares).
[Ville de] Paris (Préfecture de la Seine).
[Ville de] Paris (Préfecture de police).
[Compa]gnie des chemins de fer du Nord.
[Compa]gnie des chemins de fer de [l'Oue]st.
[Compa]gnie des chemins de fer de Paris [à Ly]on et à la Méditerranée.
[École s]upérieure de télégraphie.

Allemagne (Empire d').

Ministerium der oeffentlichen Arbeiten und Herzoglich Braunschweigshes Communion Hüttenamt.

Amérique du Nord (Etats-Unis de l').

United States Signal Office.
Bureau des brevets des Etats-Unis d'Amérique.
Smithsonian Institution (Washington)

Angleterre.

Society of Telegraph Engineers and Electricians.

Autriche (Empire d').

Ministère de la guerre.
Administration de la Société Autrichienne I. R. P. des chemins de fer de l'Etat.

Belgique (Royaume de).

Observatoire royal de Bruxelles.
Compagnie des télégraphistes de campagne.
Ville de Gand.

Danemark (Royaume de).

Direction des télégraphes d'Etat.

Espagne (Royaume d').

Direction générale des postes et des télégraphes.

Italie (Royaume d').

Ministère de l'agriculture.
Ministère de l'instruction publique.
Etablissement de l'Etat pour la fabrication des cartes-valeurs.
Institut royal topographique militaire.

Japon (Empire du).

Ministère des travaux publics (Administration des télégraphes).

Norvège (Royaume de).

Institut topographique de Christiania.

Pays-Bas (Royaume des).

Administration des télégraphes de l'Etat.

Russie (Empire de).

Ministère de la marine.
Département des télégraphes.
Etat-major (section topographique).
Expédition pour la confection des papiers de l'Etat.
Société impériale polytechnique russe.

Suède (Royaume de).

Administration des télégraphes de Suède.
Génie militaire suédois.

Suisse (Confédération).

Administration des télégraphes suisses.
Bureau international des administrations télégraphiques (Berne).

DIPLOMES D'HONNEUR

DÉCERNÉS AUX ÉTABLISSEMENTS INDUSTRIELS.

France.

Breguet.
Christofle et Cie.
Société générale des téléphones.

Allemagne.

Siemens et Halske.

Angleterre.

Eastern Telegraph Co.
Siemens Brothers and Co. limited.
Submarine Telegraph Co.
Telegraph Construction and Maintenance Co. limited.

DIPLOMES D'HONNEUR.

DÉCERNÉS AUX INVENTEURS.

Baudot	France.
Bell (Alexander Graham)	Etats-Unis.
Bjerknes	Norvège.
Deprez (Marcel) ...	France.
Edison	Etats-Unis.
Gramme	France.
Hughes...	Angleterre.
Pacinotti	Italie.
Planté (Gaston) ...	France.
Siemens (Dr. Werner)	Allemagne.
Thomson (Sir William)	Angleterre.

DIPLOMES DE COOPERATION

France.

Collége de France (cabinet de physique).
Collége de France (laboratoire d'histoire naturelle des corps organisés).
Conservatoire national des arts et métiers.
Muséum d'histoire naturelle de Paris.
Guebhard (Adrien).
Trève (commandant).

Allemagne (Empire d').

Kœnigliche Eisenbahn-Direction (Berlin).
Kœnigliche Eisenbahn-Direction (Elberfeld).
Kœnigliche Eisenbahn-Direction (Frankfurt am Mein).
Kœnigliche Eisenbahn-Direction (Hannover).
Senats-Commission für Reichs-und auswærtige Angelegenheiten (Bremen).
Universitæt Berlin: Physiologisches Institut.
Technische Hochschule Berlin: Physikalisches Cabinet.
Polytechnikum Dresden: Physikalisches Cabinet.
Universitæt Gœttingen: Erdmagnetisches Observatorium und Physikalisches Institut.
Polytechnische Schule Karlsruhe: Physikalisches Cabinet.
Universitæt Leipzig: Physikalisch-Chemisches Institut.
Universitæt Marburg: Mathematisch-Physikalisches Institut.
Kœnigliche Akademie Munster: Physikalisches Cabinet.
Universitæt Rostock: Physiologisches Institut.
Universitæt Wüerzburg: Physikalisches Institut.
Frœlich (Dr. O.), à Berlin.
Weber (Dr. L.), à Kiel.

Angleterre.

King's College (administration of).
Royal Institution of Great Britain.

Autriche (Empire d').

Administration du chemin de fer de Buschtiehrad à Prague (Bohème).
Kohlfürst et Jetsche.
Mach (professeur), à Prague.
Pfaundler (professeur), à Innsbrück.
Puluj (docteur J.), à Vienne.
Von Waltenhofen (professeur à Prague).

Belgique (Royaume de).

Académie royale des sciences, des lettres et des beaux-arts de Belgique.
Maison des Joséphites, à Mesle-les-Gand.
Musée royal de l'industrie, à Bruxelles.
Société scientifique de Bruxelles.
Université de Louvain.
Université libre de Bruxelles.
Melsens.
Somzée.

Hongrie (Royaume de).

Antolik.

Italie (Royaume d').

Institut royal des sciences et des lettres de Milan.
Musée royal de Florence (cabinet de physique).
Musée royal de Florence (cabinet des anciens instruments d'astronomie et de physique).
Université royale de Gènes (cabinet de physique).
Université royale de Modène (cabinet de physique).
Université royale de Naples (cabinet de physique).
Université royale de Padoue (institut de physique).
Université royale de Pavie (cabinet de physique).
Université royale de Pise (cabinet de physique).
Université royale de Turin (cabinet de physique).
Lycée Spallanzani de Leggio (cabinet de physique).
Lycée Volta de Come (cabinet de physique).
Lycée de Vérone (cabinet de physique) Rossi (Michel-Etienne de).

Pays-Bas (Royaume des).

Administration du service des pompiers, à Amsterdam.
Fondation Teyler (cabinet de physique), à Haarlem.
Bosscha (Johannes), directeur de l'école polytechnique, à Delft.

Russie (Empire de).

Université impériale de Moscou (laboratoire de physique).

Suede (Royaume de).

Université de Lund.

Suisse (Confédération).

Colladon (Daniel).

MEDAILLES D'OR.

Achard	France.
Ader	—
Anglo-American Brush Electric Light Corporation limited ...	Angleterre.
Arlincourt (d')	France.
Bright	Angleterre.
British Electric Light Co	—
Bürgin	Suisse.
Carels frères	Belgique.
Carpentier	France.
Charrière et Cie ...	—
Collin	—
Compagnie des chemins de fer de l'Est ...	—
Campagnie du chemin de fer de Paris à Orléans	—
Compagnie générale belge de lumière électrique...	Belgique.
Compagnie générale d'éclairage électrique	France.
Crompton	Angleterre.
De Vos	Belgique.
Deschiens	France.
Digney	—
Duboscq	—
Ducretet et Cie... ...	—
Dumoulin-Froment ...	—
Elliot frères	Angleterre.
Farcot (Joseph) ...	France.
Félix (Clement) ...	—
Felten et Guilleaume Carlswerk	Allemagne.
Gaiffe	France.
Garnier (H.)	—
Garnier (P.)	—
Geissler	Allemange.
Gloesener (Mlle) ...	Belgique.
Golfarelli	Italie.
Gravier, Kuksz, Leudtke et Grether	Russie.
Gray (Elisha)	Etats-Unis.
Gülcher...	Autriche.
Hardy, Hayet et Ligneux, successeurs ...	France.
Hefner von Alteneck ...	Allemagne.
Heilmann Ducommun et Steinlien	—
Henry-Lepaute ...	France.
Hipp	Suisse.
India Rubber gutta-percha and Telegraph Works Co. limited ...	Angleterre.
Jaspar	Belgique.
Jousselin	France.
Jürgensen et Lorenz ...	Danemark.
Kaiser	Pays-Bas.
Latimer Clark, Muirhead and Co. ...	Angleterre.
Lartigue	France.
Le Boulengé	Belgique.
Lenoir	France.
Menier	—
Mercadier	—
Meritens (de)	—
Meyer	—
Mors	—
Nord-Deutsche Affinerie	Allemagne.
Olsen	Norvège.
Orduna (Carlos de) ...	Espagne.
Otto (pour les moteurs à gaz exposés par la compagnie française des moteurs à gaz, par MM. Fetu et Deliège et par la Gasmotorenfabrik zu Deutz) ...	Allemagne.
Piette et Krizik ...	Autriche.
Pollitzer	—
Postel-Vinay	—
Rattier et Cie.	—
Redier et G. Tresca ...	—
Regnault	France.
Sautter, Lemonnier et Ce	—
Schæffler (Otto) ...	Autriche.
Schubart	Belgique.
Sebert (lieut.-col.) ...	France.
Serrin	—
Société des usines électro-métallurgiques d'Auteuil	—
Société générale d'electricité	—
Société Gramme ...	—
Société lyonnaise de constructions mecaniques et de lumière électrique	—
Sörensen	Suède.
Swan (J.-W.)	Angleterre.
Tainter (Sumner) ...	Etats-Unis.
Tesse	France.
United States Electric Lighting Co. (système Maxim)	Etats-Unis.
Van Rysselberghe ...	Belgique.

AILLES D'ARGENT.

ation de l'ex-
on des chemins
e l'Etat ... Suède.
ation du che-
fer de Lem-
Czernowitz ... Autriche.
... ... Angleterre.
d aîné ... France.
... ... Russie.
Perry ... Angleterre.
Puskas ... Etats-Unis.
Fenestre ... France.
.) ... ... —
yrille) ... —
ole d'horolgie
s) ... ... —
... ... —
... ... —
.. ... —
... ... Espagne.
ne) ... ... France.
... ... —
V.-G.-A.) ... Etats-Unis.
... ... France.
Pâris ... —
t de Jaer ... Belgique.
od ... ... Angleterre.
t et Cie ... Belgique.
... ... Italie.
... .. Suède.
mond) ... France.
dinand) ... —
... ... —
... ... Italie.
t Guyot-Sion-
... ... France.
... ... —
... ... —
... ... —
... ... —
r ... .. —
Marin Darbel —
ié ... ... —
... ... Belgique.
e anonyme des
e Châtillon et
ntry ... France.
e parisienne
ge par l'élec-
ancienne alli-
... ... —
Brothers & Mac
... ... Etats-Unis.
ed Telephone
Maintenance Angleterre.
... ... France.
... ... Belgique.
Law ... France.
t-Bouillet ... Belgique.
et Bourdoncle France.
toff-Maïkoff Russie.
... ... Etats-Unis.
... ... France.
... ... —
Alker ... Belgique.
... ... Etats-Unis.
Iorlogerie de
... ... France.
... ... Autriche.
urifier Co. ... Etats-Unis.
namic Co. ... —
.-M.) et Co. Suède.
Telegraph Co.
... ... Angleterre.
-D.)... France.
... ... —
... ... Hongrie.
(de) frères ... Belgique.
... ... Angleterre.
ersher et Cie. France.

Gérard (A.) ... ... France.
Gérard et Germot ... —
Ginori ... ... Italie.
Guillemart (Edmond)... France.
Gurlt ... ... Allemagne.
Hache et Pépin-Lehal-
leur ... ... France.
Hartmann ... ... Allemagne.
Hasler ... ... Suisse.
Héquet ... ... France.
Hubbard ... ... Etats-Unis.
Humblot ... ... France.
Jacquemier ... ... —
Jarriant ... ... —
Johnson and Nephew... Angleterre.
Kaiserliche General-
Direction der Eisen-
bahnen in Elsass-
Lothringen ... ... Allemagne.
Kremenecky ... ... Autriche.
La Horden et Bonet ... Espagne.
Le Goarant de Tromelin France.
L'Hôte ... ... —
Lenczewski ... ... —
Létrange et Cie. ... —
Lermontow ... ... Russie.
Locht Labye (de) ... Belgique.
Maiche et Cie. ... ... France.
Mandroux ... ... —
Mignon et Rouart ... —
Mildé fils ... ... —
Monnier ... ... Suisse.
Montefiore-Lévi ... Belgique.
Moquery ... ... France.
Mouchel ... ... —
Müller ... ... Allemagne.
Naglo frères ... ... —
Napoli ... ... France.
Naudin et Schneider ... —
Newall ... ... Angleterre.
Noé ... ... France.
Olland ... ... Pays-Bas.
Olry et Grandemange France.
Petit (G.) ... ... —
Piat ... ... —
Philips (Williams) ... Etats-Unis.
Pierucci... ... ... Italie.
Racagni et Guglielmini —
Pond Indicator Co. ... Etats-Unis.
Rediguet (C.-A.) ... France.
Raphael (Max) ... Allemagne.
Rault et Chassan ... France.
Renaudot et Magniny —
Reynier... ... ... —
Richard... ... ... Italie.
Robey and Co. ... Angleterre.
Rouvier ... ... France.
Sabine ... ... Angleterre.
Saxby et Farmer ... —
Schweizer ... ... Suisse.
Sedlacek ... ... Autriche.
Seguy (Veuve Hector et
Fils) ... ... France.
Sieur ... ... —
Société anonyme de
constructions mecan-
iques d'Anzin ... —
Société anonyme des
hauts-fourneaux, fon-
deries et forges de
Franche-Comté ... —
Société anonyme de
Grivegnee ... ... Belgique.
Société anonyme de
Lessjofors ... ... Suède.
Société "la Force et la
Lumière" ... ... France.
Société nouvelle des
forges et chantiers de
la Méditerranée ... —
Société suisse des télé-
phones ... ... Suisse.

Spagnoletti ... ... Angleterre.
Stœhrer und Sohn ... Allemagne.
Suisse ... ... France.
Taverdon ... ... —
Terral (jeune) ... ... —
Thiers ... ... —
Thomson Sterne and
Co., Limited ... Angleterre.
Tommasi ... ... France.
Trouvé ... ... —
Van den Kerchove ... Belgique.
Van Wetteren (Nicolas) Pays-Bas.
Varral, Elwel et Mid-
dleton ... ... France.
Vavin ... ... —
Voss ... ... Allemagne.
Weill (F.) ... ... France.
Welsch ... ... Belgique.
Wennman ... ... Suède.
Western Electric manu-
facturing Co. ... Etats-Unis.
Weston Electric Light Co. —
Willot ... ... France.
Wittwer et Wetzer ... Allemagne.

MEDAILLES DE BRONZE.

Aboilard ... ... France.
Académie d'aérostation
météorologique ... —
Alamagny et Oriol ... —
Albaret ... ... —
Amsler ... ... Suisse.
Arnould... ... ... France.
Avoiron et Clement ... —
Bacle ... ... —
Baillehache (de) ... —
Ballat ... ... —
Ball ... ... Etats-Unis.
Bandieri ... ... Italie.
Barbey ... ... France.
Barluet et Cie ... ... —
Barrière et Cie... ... —
Bartelous ... ... Belgique.
Baudet (Cloris) ... France.
Beau (Nicolas) ... —
Beaufils ... ... —
Bédollière (de la) ... —
Bellet (Louis) ... ... —
Bernard... ... ... —
Bessand et Cie... ... —
Bigeon ... ... —
Biloret et Mora ... —
Bisson ... ... —
Bizot ... ... —
Blakey, Emmot and Co. Angleterre.
Blix ... ... Suède.
Blondeau ... ... France.
Blouzon... ... ... —
Borgmann ... ... Russie.
Boudreaux ... ... France.
Boulet et Cie ... ... —
Bourdin (J.) ... ... —
Bourne ... ... Angleterre.
Brand ... . Belgique.
Brunnschweiler et fils... Suisse.
Buss ... ... France.
Cacheleux ... ... —
Callaud ... ... —
Cance ... ... —
Canson et Montgolfier —
Carue ... ... —
Castelli ... ... Italie.
Cavignato ... ... —
Cefrey ... ... France.
Chapuis... ... ... —
Charle ... ... Belgique.
Chavet ... . Etats-Unis.

Chertemps	France.
Chollet et Rezard ...	—
Chutaux	—
Combettes (de) ...	—
Compagnie des bronzes	Belgique.
Compagnie française du celluloïd	France.
Compagnie internationale des téléphones de Bruxelles	Belgique.
Cordier (aîné et fils) ...	France.
Cottens	—
Courtot	—
Coxeter and Son ...	Angleterre.
Croon et Cie	Pays-Bas.
Cumming	Etats-Unis.
Cuypers	Allemagne.
Dalifol et Cie	France.
Dandigny	—
Daville (Auguste) ...	—
Dawans et Orban ...	Belgique.
Debayeux	France.
Deffez	—
Delahaye	—
Delamotte	—
De la Roche et Mayrhofer	—
De la Taille	—
Delaurier	—
Delaye	—
Deleuil	—
Dolgorouki (Prince) ...	Russie.
Delsaux...	Belgique.
Denis-Fouillet	France.
Dereviankine	Russie.
Desguin	Belgique.
Dion	Etats-Unis.
Dœrffel	Allemagne.
Dopfeld	France.
Dorizon	—
Douce et Cie	—
Dubos	—
Ducousso frères ...	—
Dupont (J.)	Belgique.
Echenique	Espagne.
Eliaers	France.
Engel	—
Engstrom (Edward) ...	Suède.
Estienne	France.
Evely	Belgique.
Fautrier...	Italie.
Fein	Allemagne.
Ferry et Millet ...	France.
Flechet et Cie	Belgique.
Fontenilles	Franee.
Forest...	—
Foxcroft	Angleterre.
Frémond	France.
Frenais	—
Frion et Thierré ...	—
Galante...	Espagne.
Gallet (Victor)... ...	France.
Gary	—
Gauthier	—
Gautret	—
Geissler (Nicolas) ...	Russie.
Gerosa	Italie.
Geesbergen (Jean) ...	Belgique.
Gerzabeck, Zeller et Cie	Allemagne.
Giesbers	Belgique.
Giraud...	France.
Gits	—
Godage (Hans) ...	Norvège.
Goppelsroeder... ...	Suisse.
Grandfeld	Autriche.
Gras	—
Grassl et Beux ...	—
Gravollet	Autriche.
Grin	—
Grivolas	—
Grosguénaint	—
Guggemos	—
Guichard et Cie ...	—
Hammelle et Fleutelot	—
Hedges-Killingworth...	Angleterre.
Hempel	France.
Holmgren	Suède.
Hoosach Tunnel trinitroglicerine works	Etats-Unis.
Horn	Allemagne.
Hospitalier	France.
Hubin	—
Humblot et Terral ...	—
Hunebelle	—
Hurtu et Hautin ...	—
Hutchinson & Co. ...	—
Jacobs	Pays-Bas.
Jacquez	France.
Jean	—
Joly	—
Jordery	—
Journaux	—
Jowa	Belgique.
Kern	France.
Keiser et Schmidt ...	Allemagne.
Kovaco...	Russie.
Legarde	France.
Laneuville et Pers ...	—
Lapointe	—
Latchinoff	Russie.
Leveissière et fils ...	France.
Leblanc et Loiseau ...	—
Leclérc	—
Leduc	Belgique.
Legat	France.
Leguay	—
Lemoine	—
Lessing...	Allemagne.
Létard...	France.
Le Tellier et Vertraet	—
Letourneau	—
Liébert	France.
Lionnet...	—
Loiseau (Edouard) ...	—
Loiseau et Guichard ...	—
Luizard...	—
Mangenot	—
Mantelet et Joly ...	—
Marcillac	—
Mathieu	—
Michel	—
Milchsack et Cie. ...	Allemagne.
Mills	Pays-Bas.
Mirand fils	France.
Mirandolle	Pays-Bas.
Monti	France.
Mouchère fils	—
Mourlon	Belgique.
Mugna	Italie.
Nacfer	France.
Neujean	Belgique.
Nigra	Italie.
Noblet	France.
Noel	
Lawlor (O.)	Angleterre.
Olin et fils	Belgique.
Ollivier	France.
Olsen	—
Oré et Chagnoleau ...	—
Papin	—
Parent (Georges) ...	—
Partz	Etats-Unis.
Paterson	Angleterre.
Patry	France.
Pelletier	France.
Perez-Blancas	Espagne.
Pérille	France.
Perin-Grados	—
Petit (Pierre)	—
Photo-Relievo & Co. ...	Etats-Unis.
Piedras y Macho ...	Espagne.
Planche fils	Belgique.
Radiguet et fils ...	France.
Raffard	—
Ragosine	Russie.
Raikem	Belgique.
Ransomes, Head & Jefferies	Angleterre.
Rebiceck	Autriche.
Richez et Cie	Belgique.
Rose	France.
Roullier et Arnoult ...	—
Rous	—
Sabel	Angleterre.
Sacre	Belgique.
Sambourg	France.
Samson...	—
Sax	Angleterre.
Schneider et Cie ...	France.
Serravalle	Italie.
Seure	France.
Skrivano	Russie.
Slouguinoff	—
Smith	Angleterre.
Société anonyme de câbles électriques, système Berthould, Borel et Cie...	France.
Société anonyme de Skultuna	Suède.
Société anonyme le Nickel	France.
Société générale pour la fabrication de la dynamite	—
Société parisienne et fonderie et laminage	- -
Société d'études et constructions électriques zurichoise	Suisse.
Solignac et Cie. ...	France.
Sommati di Monbello	Italie.
Stiff and Sons	Angleterre.
Stoesser...	France.
Tagaitschinoff... ...	Russie.
Tegnander	Suède.
The Dowson Economic Gas Company ...	Angleterre.
Tichomiroff	Russie.
Tissandier	France.
Tostrup	Norvège.
Vaillant, Leclerc et Gourdon	France.
Vanderbiste	Belgique.
Van der Ploeg	—
Vandevelde	—
Van Hulle	—
Vauzelle et fils	France.
Videcoq	—
Vigouroux et Andriveau	—
Waelput	Belgique.
Wallis & Stevens ...	Angleterre.
Weiller et Montefiore Lévi	France.
Whitecross Wire Company	Angleterre.
White house Mills ...	Etats-Unis.
Williams	—
Wilk	Allemagne.
Wisse Piccaluga et Cie.	Pays-Bas.
Wolff	France.

THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

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THOMAS ALVA EDISON.

THOMAS ALVA EDISON.

America has long been renowned as the land of mechanical invention; but she has conspicuously distinguished herself during the last few years. This has been largely due to the genius of Mr. Edison, who, by his many remarkable inventions, which it is needless to enumerate, has drawn upon himself and his native country the attention of both the learned or unlearned in the whole world. Mr. Edison is the chief figure amid a perfect host of inventors, great and small, who swarm in the United States; and being also a self-made man, he has been almost worshipped by his countrymen. There was something almost magical in these inventions, which appealed powerfully to the imagination; and when it was known that their author was a self-taught telegraph clerk, who looked a mere boy, it is no wonder that Edison was lionised as he has been. Such a character, like Balsac in fiction or Mademoiselle Bernhardt in art, breaks the commonplace monotony of existence, and lets loose those hidden springs of enthusiasm which are ever ready to welcome anything in the shape of a prodigy.

Thomas Alva Edison was born at the village of Milan, in Erie County, Ohio, on February 11th, 1847, and is therefore nearly 35 years of age. His father was of Dutch descent, and had been in turns a tailor, a nurseryman, and a dealer in land and lumber. His mother, though born in Massachusetts, was of Scotch parentage and a woman of good education, she having formerly been a school teacher in Canada. Indeed, she may be regarded as the sole teacher of her boy, for the two months' regular schooling he received is of no account. Like many other famous men, therefore, Edison was much indebted to his mother.

Like many other famous men, too, Edison, as a boy, was fond of amusing himself alone. He was a great reader, and did not complain about the nature of a book, so long as it was a book of some kind. It is related that he once set himself to read through an entire subscription library, beginning at the bottom shelf, and that he had penetrated several shelves before his project was given up. At ten we find him reading books of chemistry, and when he began the world as a train-boy on the Grand Trunk Railway of Canada and Central Michigan, he littered the empty baggage car, which served him as a store for his fruit and newspapers, with old retorts and bottles of chemicals, which he had picked up at odd times for a few pence.

With the Yankee instinct for "getting on" abnormally developed, he purchased a second-hand printing press, together with a quantity of type, and started a newspaper of his own, entitled, "The Grand Trunk Herald." Of this literary venture he was proprietor, editor, staff, publisher, printer, and devil, in his own person; and it obtained the flattering celebrity of being noticed in the London *Times* as the only paper printed and circulated in a railway train.

During this time he was investigating everything mechanical which came under his notice. He pored over the working of the telegraph, he studied the locomotive, and once ran the train between two stations himself. He also continued his reading, and "Newton's Principia," side by side with "Ure's Dictionary of the Sciences," and "Burton's Anatomy of Melancholy," could have been seen on the news-boy's shelf. He also took to chemical experiments in an evil day for the pursuance of his news business, for one day he accidentally set fire to the baggage-car, and the irate conductor put a summary end to his literary career and his scientific researches, by ejecting him and all his traps, chemicals, fruit, and printing press included, out of the car.

From his first acquaintance with it, the telegraph has exercised a strong attraction over him; and it was a turning-point in his life when, after he had gallantly rescued a child of the Port Clements station-master from being run over on the line, the grateful father undertook to teach Edison how to telegraph.

Edison was meanwhile turning his versatile talents to account as a shoemaker, a trade which he had picked up in some unaccountable way; but the work was distasteful, and he took a situation at Port Huron, Michigan, as a telegraphist.

From this time, for several years, he led the life of a travelling operator, now engaged in Canada, now in Indianapolis, now in Cincinnati, or Louisville, now in Memphis and Boston. Many amusing stories are told of his ready ingenuity and gawky appearance during this period. His mind was now fairly directed towards invention, and he acquired the habit of experimenting and thinking at night, after the duties of the day were over. At Memphis in 1864, we are told, that he devoted himself to the problem of duplex telegraphy, and, after having his studies and ideas frequently ridiculed and discountenanced by his ignorant fellow clerks and masters, he found his way to Boston in 1868, where he met with more encouragement and better success. "In spite of his peculiar fashions of passing his time," says a writer in *Scribner*, "he had become one of the most accomplished operators. He overcame obstacles put in his way on account of a somewhat uncouth appearance, and soon took an important position. He had up to this time dallied with a number of ideas he has since perfected, acquired a beautiful, small, rapid handwriting, as clear as print, and gratified considerably his desire of seeing the world. He had once been on the point of sailing for South America, from New Orleans, but had only been prevented by an accident. A new period commenced for him. Some small things of his succeeded—a dial instrument for private use, a chemical note-recorder, and others, and he began upon a vibratory principle of telegraphing. He commenced a great epoch in one's history—to believe in himself. Up to this time he had not done so. 'I did not think,' he says, 'that I was competent.' He was not successful, however, in an important trial of his duplex system, and was soon again adrift."

He went to New York in a disconsolate mood, and happening to be in the office of the Gold and Stock Company at a critical moment when their indicator was out of order, he repaired the instrument, and secured an engagement with the company. He soon invented a printer of stock which was adopted by the company, and from that time his progress was assured. He was also taken up by

the Western Union Telegraph Company, and retained by both companies at a handsome salary, to give them the first bid for his new inventions. He was now in a position to start a manufactory of his own at Newark, New Jersey, where he made all his gold and stock printers, and employed about 300 men; but the business left him too little leisure for invention, so he sold out and retired to Menlo Park, a new settlement of a few yellow-painted wooden houses on the Pennsylvania Railway in New Jersey, about 20 miles from New York. Here he built a large barn-like structure upon the top of a hillock, and fitted it out as a workshop and laboratory, the workshop being on the basement and the laboratory upstairs. The former is well supplied with tools, lathes, and workmen, who are kept busy making patterns and transforming the inventor's ideas into wood and iron; while the latter is stocked with books, experimental apparatus, and so many chemicals besides that it looks like a wholesale drug-store. He is said to buy a quantity of every new drug which appears in the market, for he does not know how soon he may want it in his experiments; but we suspect that he has a passion for surrounding himself with chemical compounds, just as a bibliophile has a passion for surrounding himself with books. In this laboratory, Edison has everything at his command; he is provided with several skilful assistants selected by himself for their zeal and ability, who are ready to test all his suggestions, and also to offer ideas of their own. He has workmen to make all the instruments and models he may require, and what is more he can give all his time and thought to the work he has in hand. Menlo Park is an inventors' paradise not to be found in any other country; and though this fact tends to lessen our surprise that Edison should have accomplished so much, we ought not to forget that it was his own genius and industry which first created the place. We need not dwell at length on his several inventions, for they have been so frequently cited and published of late, that they are familiar to most electricians. Before the invention of the loud-speaking telephone and the phonograph had enormously extended his fame, Edison was becoming known on this side of the Atlantic as a rising young genius, sure to do wonders in his day, and his gold and stock printer, his electric pen, electro-motograph, and quadruplex system, had given him a solid reputation as an electrical inventor. Then came the invention of the carbon telephone, the phonograph, and microtasimeter, which swelled his fame to world-wide bounds, and finally, as if to inflate it to bursting point, he telegraphed the enthusiastic but rash announcement across the Atlantic in October, 1878, that he had solved the problem of the divisibility of the electric light, and would soon be able to light up our homes by electricity, at a mere fraction of the cost of gas. A year or two has since passed by, and although the letter of the announcement cannot yet be said to have been fulfilled, yet, by dint of ceaseless energy, Edison has gone far towards accomplishing what he anticipated. The exhibit at the Paris Electrical Exhibition shows that he has overcome some of the obstacles in his way, and that he has attained a large measure of success. The invention of the phonograph is undoubtedly one of the most transcendent flashes of mechanical inspiration that ever entered into the mind of a man; and the loud-speaking telephone, with its carbon transmitter and prepared chalk receiver, is one of the greatest marvels ever constructed out of dead matter. On hearing it and examining it, we cannot but wonder at the daring hardihood and patience of invention which has made it what it is.

Edison has taken out in all about three hundred patents. He has been called "the young man who keeps the road to the Patent Office hot with his footsteps." His plan appears to be to patent all the ideas that occur to him, whether tried or untried, and to trust to future labours to select and combine those which prove themselves the fittest. The result is that the great bulk of his patents are valueless in point of practicability; but they serve to fence the ground in from other inventors.

From our illustration, it will be seen that Edison's appearance is youthful in the extreme. "When you go to his house," says a writer, "he may very possibly answer your inquiry for 'Mr. Edison' himself; or, if not, you will be shown into his laboratory, where you will find him among his assistants; and if you try to guess which is Mr. Edison, your best plan will be to select the least obtrusive person in the group. His figure is slight and young-looking, though the face, from its long habit of concentration, has an old look; he has a frank, cordial expression, and, like most men of great powers, can be almost a boy when his attention is turned away from his absorbing interests. But when he is not aroused, he seems to retire within himself, as if his mind had travelled a long way off, and his attention comes back slowly. He has the peculiar pallor of a night worker, and if you stay with him through the night, you will find him as bright at the end of the vigil as at the beginning." His power of work is something extraordinary, it being usual for him to work sixteen hours each day, and at a stretch; as, for example, when he invented the phonograph, he has eschewed sleep for days and nights on end. More than one assistant has already succumbed to the strain of trying to keep up with him.

Mr. Edison is married, and has three children, two boys and a girl, one of each sex being nicknamed respectively Dot and Dash. He is young, and as he comes of a long-lived stock, notwithstanding the severe strain to which he subjects his powers, we may reasonably expect that he will continue to bestow many useful inventions on his age. We can assure him that should he ever fulfil his intention of coming to England, he will meet with a cordial reception from English electricians.

THE CRYSTAL PALACE ELECTRICAL EXHIBITION.—The Postmaster-General has arranged with the Crystal Palace Company to exhibit the whole of the instruments now exhibiting at the Paris Exhibition by the British Postal Telegraph Department. In addition, there will probably be shown in actual use several of the best fast-speed instruments employed by the department.

THE ELECTRIC LIGHT.—The Duke of Sutherland has decided upon lighting his residence at Trentham with the electric light supplied by the British Electric Light Company.

THE PARIS ELECTRICAL EXHIBITION.

FOREIGN SECTIONS.

DR. ANTONIO COSTA SAYA, PROFESSOR OF PHYSICS IN THE UNIVERSITY OF MESSINA.

"MAGNETIC DYNAMOMETER."—The principal part of this instrument consists of two magnets, *a b*, Q B, and a scale, *d g* (fig. 1), arranged upon a rectangular base of wood. The two magnets are placed one above another in such a manner that the axes of symmetry are horizontal and in the same vertical plane. Each of these two magnets carries a very slender index, *i* (fig. 2), I (fig. 3); placed at right angles with the axis of symmetry and in the medium horizontal plane of its thickness.

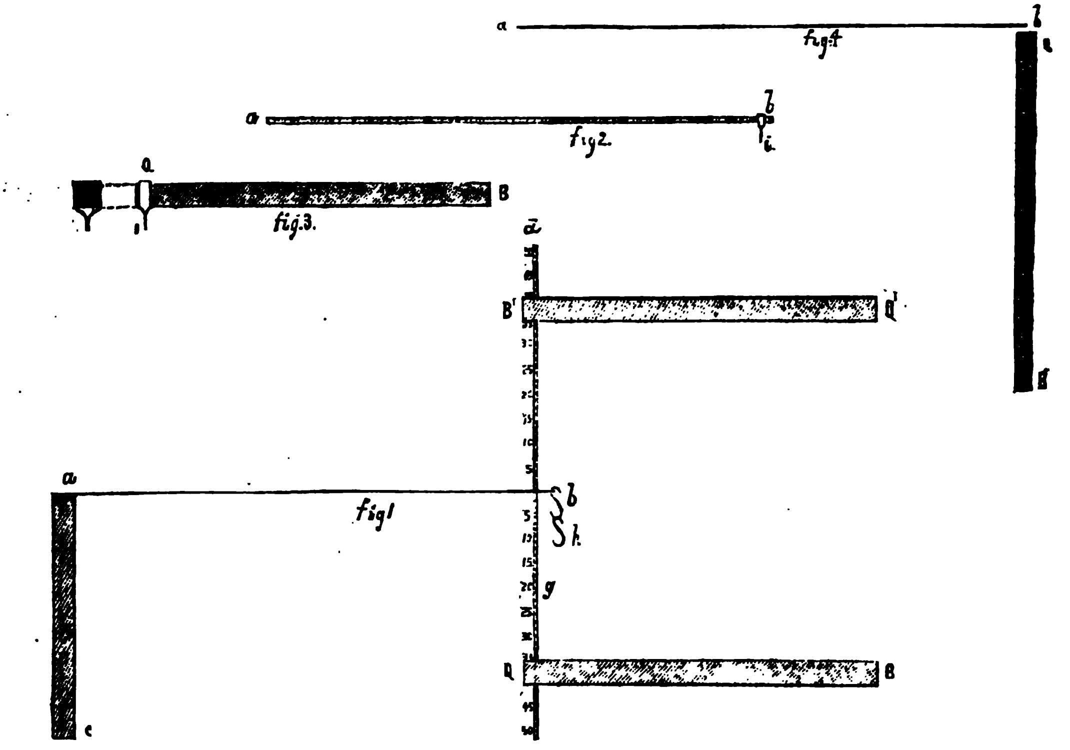
firm and it should not be affected by the oscillations of the floor.

The second magnet, Q B, is placed upon a movable toothed support, by means of which it can be aproximated to the other magnet, *a b*, or removed from it. Upon the button of the rack-work is a set-screw to fix the support of the magnet, Q B, at the desired height.

In such an instrument the magnetic attraction or repulsion is counterbalanced by the elasticity of flection. The following experiments will exemplify the method of working the apparatus.

First Experiment.

The magnet, Q B, is removed from its support, and removed so far from the instrument that it cannot act upon the spring-magnet, *a b*; then it can be demon-



The first magnet, *a b* (fig. 1), is formed of a long, narrow and thin spring of steel, which is fixed horizontally at one end, *a*, to a perpendicular support, *a c*, and left free at the other extremity, *b*; the latter carries the index, *i*, which by bending *a b* slides along the scale, *d g*; this scale is finely divided into equal graduations, and can be raised or lowered. In order to secure the scale in its exact position before experimenting, the second magnet, Q B, is removed from its support and the scale fixed by means of a set-screw, so that its zero corresponds precisely to the index, *i*, of the spring, *a b*. The *plane upon* which the magnetic dynamometer is *placed during* experimentation ought to be very

strated that the inflection of *a b* is proportional to the force which produces it. At *b* there is suspended a very slender copper wire of the form of S for the purpose of lowering the index, *i*, a short distance, *l*, from the scale, *d g*; to the weight there is appended a second one, *h*, of equal weight, so that the index can be lowered to, 2 *l*, and by means of other weights this lowering can be extended to any degree sufficient for the use for which the instrument is intended. If the chain of weights, *b h*, be removed the index will return to the zero of the scale, *d g*. This experiment shows that within certain limits the inflections of the spring, *a b*, are proportional to the force which produces them.

Second Experiment.

The magnet, Q B, is placed upon its support in a direction parallel to *a b*, as is indicated in fig. 1, and in such a manner that its magnetic pole, Q, corresponds to the contrary magnetic pole, *b*, of the spring-magnet, *a b*; moreover it is placed near the scale, *d g*, before which extends the index, I, fixed to a ring. This arrangement enables the index, I, to be placed at a convenient distance from the scale upon which are marked the different heights at which the magnet, Q B, is placed on raising or lowering it.

This being done and the magnet, Q B, being always kept in a parallel position, it is brought to a certain distance from the spring, *a b*, in such a manner as to cause a lowering of the index, *i*; and preserving this, the magnet, Q B, is moved slowly backwards and forwards to find the position which corresponds to the maximum depression of the index, *i*; in such movements the axis of the magnet, Q B, ought not to change its distance from the other magnet, *a b*, nor be removed laterally. When such a position of the magnet, Q B, is found, it is fixed with a set-screw and then the magnetic dynamometer is ready for experiments, by means of which it is demonstrated that magnetic attraction varies inversely as the square of the distance.

Third Experiment.

The magnet, Q B, is removed from the magnet, *a b*, until its index, *i*, marks a slight depression, *l*, and then the corresponding distance, *d*, of the two poles, *a*, *b* (measured from the distance of the two indices, *i*, I), is noted.

This being done the magnet, Q B, is approached to *a b*, it being always kept in the same parallel position so as to reduce to $\frac{1}{2}$ *d* the distance of the two poles, *a b*; it will then be seen that there is a depression of the index, *i*, quadruple that formerly obtained, on 4 *l*. Thus it is shown that the magnetic attraction between the two poles, Q and *b*, varies in the inverse ratio of the squares of their distances. On reducing then the distances of the two poles to $\frac{1}{3}$ *d*, the depression of the index will be 9 *l*, or ninefold the first, as it ought to be according to the law in question.

In making such experiments it is necessary to avoid a too close proximity of the magnets, and the first depression, *l*, must be very small.

If it is desired to make a large number of experiments in confirmation of the said law, the following method may be employed.

Fourth Experiment.

Let l, l^1, be equal depressions of the index, *i*; and $d\ d^1$, the relative distances of the two poles, Q and *b*, then in accordance with the known law

(1) $$l, d^2 = l^1, d^{12}$$

whence (2) $$d^1 = d \sqrt{\frac{l}{l^1}}$$

Let us suppose that at the known distance, *d*, there is a known depression, $l = 0{\cdot}2$ of the scale by the index, *i*, then (2) we have

(3) $$d^1 = d \sqrt{\frac{0{\cdot}2}{l^1}}$$

If we wish to know the distances, d', d'', d''', &c., of the two poles, *a* and *b*, corresponding to the depressions, $l' = 0{\cdot}4$; $l'' = 0{\cdot}6$; l''' 0·8, &c., it is sufficient to substitute for l', in the equation (3) the numerical values of the distances, d', d'', d''', and approximating successively the pole, Q, to the pole, *b*, there are obtained the depressions corresponding to the index, *i*, in conformity with the law above mentioned.

Magnetic Repulsion.

To prove the same law for magnetic repulsion, the magnet, Q B, is placed above *a b*, in the position B′ Q′ (fig. 1), parallel to *a b*, so that the two homonymous poles, *b* and B, of the two magnets may correspond in the same perpendicular. To the latter is adapted the ring which carries the index, I, laying hold of the pole, Q, which in this new position will correspond to Q′.

By this arrangement of the two magnets, the index, *i*, of the magnet, *a b*, will be depressed by the magnetic repulsion between the two similar poles, B′ and *b*. The experiments may be made in the same manner which was employed for demonstrating the law of magnetic attraction.

Distribution of Magnetism in a Magnet.

The instrument in question is useful for studying the distribution of magnetism in a magnet, Q B. For this purpose it is not placed in a parallel position, but in such a manner that the axes of symmetry of the two magnets, *a*, *b*, Q B (fig. 4), may be situated horizontally at different heights, and in two planes, vertical and perpendicular. This position of the magnet, Q B, is called the perpendicular position, to distinguish it better from the parallel position.

Let Q B be placed in the perpendicular position under *a b* (fig. 4) so that the two contrary poles, *b*, *q*, may correspond in the same vertical, and at such a distance as to have a depression of the index, *i*, equal to 9 *l*. This being done, the needle, Q B, is moved very slowly, so that its different sections may correspond successively in the same vertical of the pole, *b*; the index, *i*, will be raised till it returns to zero, and if the movement of Q B is then continued, the index will be pushed in the opposite direction, passing above zero, and rising till the homonymous pole, B, of the magnet, Q B, will be placed below *b*.

A T-shaped support assists in maintaining the magnet, Q B, in the perpendicular position, so that the above-mentioned experiment can be made convenient.

In this and other experiments, it is useful for the magnet, Q B, to be adapted to a scale for better determining the corresponding section, in the same vertical plane, which passes through *b*, when the index, *i*, marks a positive or a negative deviation or none.

Magnetic Actions through Bodies.

It is easy to demonstrate with this instrument that magnetic action is propagated without becoming weakened through many bodies. It is sufficient to interpose the bodies, holding them in the hand, between the poles of the two magnets placed in the parallel position (fig. 1) so as to have a certain depression of the index, *i*. The index will then be seen to remain motionless on interposing between the two poles copper, glass, wood, &c., and to

Fig. 1.

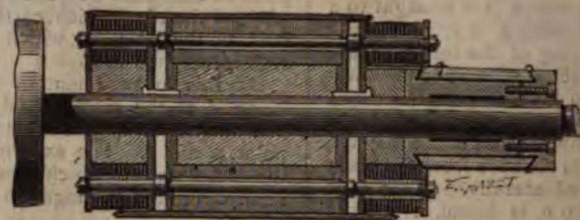


Fig. 2.

Fig. 3.—Edison's Exhibit.

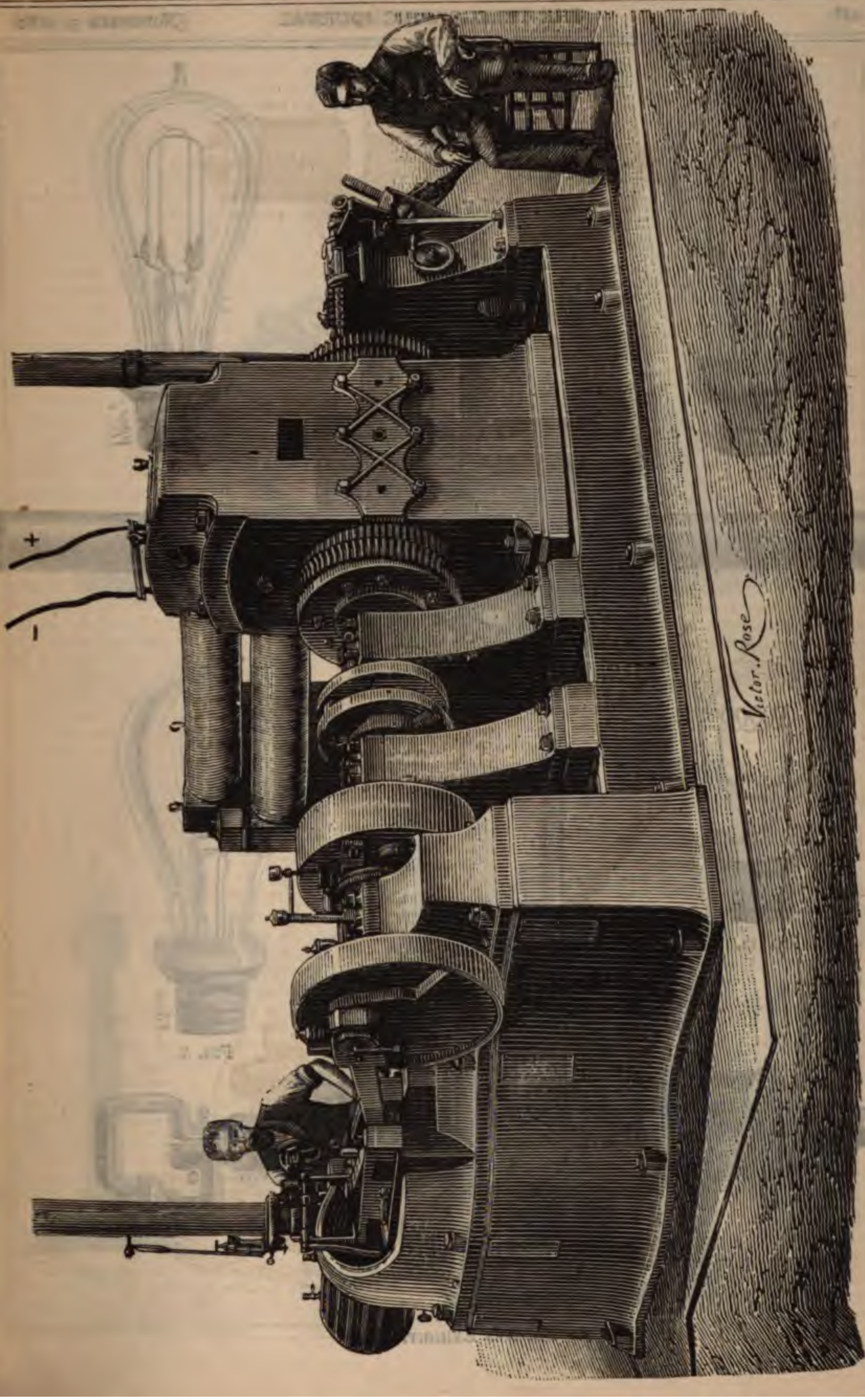


FIG. 3A.—EDISON'S EXHIBIT.

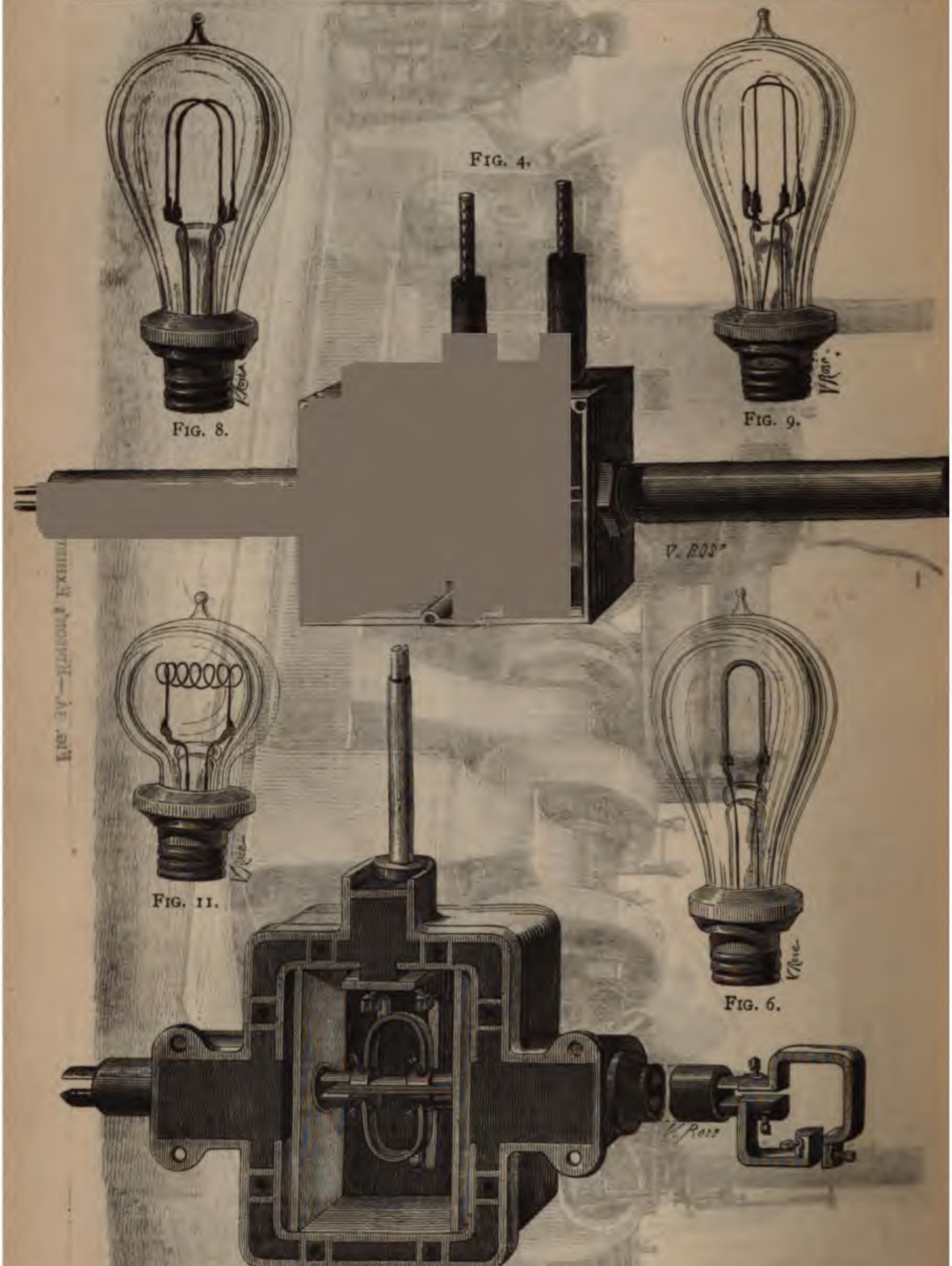


FIG. 8.

FIG. 4.

FIG. 9.

FIG. 11.

FIG. 6.

FIG. 5.—EDISON'S EXHIBIT.

FIG. 13.

FIG. 7.

FIG. 12.—EDISON'S EXHIBIT.

FIG. 10.

suddenly change its position if a plate of iron is inserted.

Action of Solenoids upon Magnets.

It will be understood that the dynamometer may give scope for new studies on the reciprocal action between a solenoid and a magnet. It will be sufficient to substitute for the magnet, Q B, a solenoid, both in the parallel and in the perpendicular position.

Electric Dynamometer.

It would be possible to have an electric dynamometer founded on the same principles. It would be sufficient to suspend to the extremity, *b*, of the spring, *a b* (fig. 1), a disc of gilt paper or a ball of elder pith, and charge it with electricity. For the magnet, Q B, must be substituted a rod of varnished glass, which supports at one of its ends another pith ball, which is charged either with the same or with the opposite kind of electricity, according as it is intended to study electric repulsion or attraction. The electric dynamometer must be inclosed in a well-fitting glass case, within which some desiccating substance must be constantly kept. The method of experimenting will be analogous to what has been already described. But special care must be had to take account of the loss of electricity in the interval of time between successive experiments.

The inventor shows that the magnetic dynamometer is preferable to the old instruments for demonstrating that magnetic action varies inversely as the squares of the distances, as well as for other magnetic and electric researches.

EDISON.

"ELECTRIC LIGHT APPARATUS."—The whole system of electric lighting by incandescence, as worked out by Mr. Edison, is of a very ingenious and practical character, and visitors at the Paris Exhibition have every opportunity of seeing for themselves the extent of perfection to which the inventor has brought his original ideas.

The Edison generator, which is of colossal size, and, together with the driving engine, weighs 17 tons, is chiefly remarkable, as regards novelty, for the construction and general arrangement of the armature; the latter differs in many respects from those employed in other machines. This armature, which is shown by figs. 1 and 2 (the latter being a section) is composed in the first place of an iron axis on which is a wood cylinder; the latter is covered by a thick iron tube formed of a series of very thin flat iron discs, separated by paper. This tube is terminated at its extremities by two large iron cheeks, which grip the plates laterally. Arranged longitudinally around the iron cylinder are a number of straight copper bars of trapezoidal cross section, and well insulated from each other by prepared brown paper; these bars take the place of the wire wound on the armatures of ordinary machines. A number of well insulated flat copper rings are strung over the central shaft at each end of the armature; there are half as many rings on either side as there are bars, that is to say, if, for example, there were 50 bars, then there would be 25 rings on either side of the armature. The left-hand rings are connected to the left-hand ends of the copper bars, two bars being connected to each disc, and the arrangement is such that in every case two bars which are diametrically opposite to one another are connected by a ring. The right-hand end of one of the two bars to which we have just referred is connected to a ring on the right hand of the armature, but this latter ring instead of being also connected to the second of the two bars alluded to, is connected to the bar next to it, whilst the opposite end of this third bar is attached to a fresh ring at the other end of the armature, and so on until all the bars have been included in one continuous electrical circuit. The iron core is thus coiled by a continuous circuit formed of the copper bars and rings; these bars and rings being of comparatively large dimensions, the total resistance of the circuit is very small (·008 ohms between the commutator brushes). Moreover, the resistance of the inactive portions of the circuit, namely the copper rings, is very trifling. In the large machine in the Exhibition there are 138 bars in the armature, the active length of each of the bars being 3½ feet. The copper rings are connected to 138 insulated copper sectors, which form a cylindrical commutator of the ordinary form; the contact brushes are arranged in the usual manner. The engine which drives the armature forms part of the whole apparatus and is of 125 horse-power. When the machine runs at a rate of 350 revolutions a minute an electromotive force of about 100 volts is obtained.

One form of dynamo machine (exhibited at the Exhibition) with the Edison armature, is shown by fig. 3; in this machine the inducing magnets are arranged vertically, but in the large machine (shown by fig. 3A) the horizontal arrangement is adopted.

The conductor for conveying the current in the Edison system consists of a metal tube about 3 inches in diameter, containing a cheap insulating substance, and traversed by two half-round copper conductors about an inch in diameter. This main pipe, which can be as long as required, is buried along the main streets, and at the side streets it has derivations branching off, to supply the current to the places it is required to illuminate. The branching off is effected by means of the arrangement shown by fig. 4; this consists of an iron box into which the conductors are led and connected to insulated terminals, to which latter are also connected the branch wires as shown. It will be noticed that the connection of the lower main wire with the right-hand branch wire is not direct, but is made through the medium of a short conductor; this latter is of lead and acts as a safety valve; should, from any cause, the strength of the current flowing out to the branch become too great, then the lead conductor melts and causes a disconnection. The whole box is hermetically sealed up so as to keep the inside perfectly dry. The conductors which are led off into the houses, are of small diameter (about 2 or 3 millimetres) and are joined on to the branch conductors, much in the same way as the latter are joined to the main conductors.

Fig. 5 shows the most perfect form of arrangement of the junction boxes for leading off from the main conductors; the general principle, it will be seen, is similar to that indicated by fig. 4.

The forms, &c., of the Edison incandescent lamps are very numerous. Figs. 6 and 7 show the simplest

arrangement, in which the incandescent carbon is formed by a single horse-shoe. Fig. 8 shows a double horse-shoe, the two being coupled up for "quantity." Fig. 9 also shows a double horse-shoe, but in this case the two are coupled up in "series." In fig. 10 a large surface is obtained by means of four horse-shoes coupled up for quantity, and in fig. 11 a large surface is obtained by employing a long filament coiled into a spiral.

Fig. 12 shows a wall bracket lamp, formed with a single glass bulb, and fig. 13 a chandelier with 3 lamps. A large chandelier with 80 lights is shown by fig. 14. In cases where a folding wall bracket lamp, as shown by fig. 15, is required, special contrivances are necessary to keep up the continuity of the circuit at the folding joints, A and B; the way in which this requirement is effected is shown by figs. 16 and 17, the former also showing the arrangement of the tap for turning the current on and off. Referring to fig. 16, which shows the tap, the object aimed at was a means of breaking the current without causing the disjunction to produce a destructive spark; this object was attained by effecting the break through the interposition of a copper cone which terminated the screw of the tap and which moved away from between two thick copper plates which were in the line-circuit; the continuity being thus broken between two points, both of which had large surfaces, the resulting spark produced but little effect. Fig. 18 shows another form of a tap on the same principle; this tap is provided with a lead safety wire (seen towards the top left hand corner of the figure), which melts if the strength of the current exceeds a safe value. Figs. 19 and 20 show a tap for main circuits; in this case there are three cone pieces, which all move together when the tap is turned, so that the continuity of the circuit is broken at six points simultaneously.

For coal-mining purposes, Mr. Edison has designed the lamp shown by fig. 21; in this arrangement the lamp and connections are kept covered with water contained in a glass vessel, so that contact of the gas in the mine with any part of the lamp likely to become broken is impossible.

In cases where it is required to be able to diminish or increase the light given by a lamp, the arrangement shown by figs. 22 and 23 is employed; this consists simply of a number of carbon bars of different sizes, any one of which can be inserted in the circuit by turning a disc piece (shown separately in the lower part of fig. 23), which makes a contact with the carbon giving the necessary resistance. The whole set of bars are covered by a perforated cylinder (shown in fig. 22), which allows the air to circulate and keep the bars cool.

The regulation of the current strength Mr. Edison effects by means of a system of testing. This arrangement is shown by figs. 24 and 25. Referring to fig. 25, it will be seen that the rheostat, *e*, is in circuit with the inducing magnets of the dynamo machine, A; by this means the action of the latter can be regulated at will by introducing in the circuit referred to, more or less resistance according as the current in the circuit of the lamps is observed to be increasing or decreasing from its normal strength. The resistances of the rheostat are seen in fig. 24 underneath the right-hand table. They are made of thick wire, and are wound on open frames to avoid heating as much as possible.

The testing of the potential of the current in the circuit of the lamps is effected by the help of the apparatus on the left-hand table. The principle of this arrangement is as follows:—Referring to fig. 25, by shifting the two bars of the commutator *j*, over to the left, the battery, D, is connected through a resistance, *i*, of 50,000 ohms, and through the galvanometer, *n*, so that a deflection of the needle is produced, which deflection is brought within readable limits by the shunt resistance, *h*, the latter being connected between the terminals of the galvanometer; the steady deflection obtained represents a definite potential. If now the bars of the commutator, *j*, be shifted over to the right, then the battery, D, is disconnected and the wires, *c c*, connected in their place; then by noting the deflection obtained, the potential of the current passing in the conductors, *a a*, can obviously be obtained in terms of the battery, D. In practice all that is necessary in order to keep the potential in the wires, *a a*, constant, is to keep the bars of the commutator, *j*, over to the right, and then to keep the deflection constant by varying, when necessary, the resistance in the rheostat, B.

Instead of keeping the current constant by the galvanometer observation, this can be done by observing the photometric value of the light obtained from a lamp placed in the circuit; for this purpose the photometer shown by fig. 26 can be employed. By placing the chariot of the photometer at any particular position on the scale, and then varying the resistance in the rheostat, E (fig. 25), it is obvious that any required standard of illumination can be kept up in the lamps on the circuit.

We understand that Mr. Edison's English representative has taken the commanding premises at 57, High Holborn, for the purpose of exhibiting the entire Edison apparatus. Every opportunity will be given for thorough tests of the system being made by those interested in the subject.

GIOVANNI SERRAVALLE.

"AUTOMATIC APPARATUS FOR COVERING WIRES." The great demand for silk or cotton-covered copper wires for electro-magnetic apparatus has led Signor Giovanni Serravalle, mechanician of the Physical Cabinet of the University of Messina, to devise an automatic apparatus which, without any supervision, should maintain perfect uniformity and continuity of action whilst covering the entire length of any wire whatever. The machine is driven by an electric motor, for which a couple of Bunsen elements furnish a sufficient current. The complete apparatus is composed of two parts, viz., the machine which covers the wire and the motor.

The first is represented in section in fig. 1. The axle, B B, is set in motion by means of the wheel, A A, which communicates with the motor by means of an endless band (not shown in the figure). This axle transmits its motion, on the one hand, by means of a series of wheels at *c e*, to two cylinders, *i i'*, which revolve in the direction indicated by the arrows, and on the other hand by means of the wheel, A, to the coverer, E, which is

composed of another axle, L L″, parallel to the former and carrying a disc, N N¹, to which are adapted four bobbins full of silk for covering the wire. The wire enters into I, and traverses the

Fig. 14.—Edison's Exhibit.

interior of the axle, L L″, and is compressed by the two cylinders, *i i′*, which by their movement drive it outward. The silk threads coming from the bobbins after having passed through various little apertures lined with glass, reunite, two from *one side and two from* the other, on O, which *is on the same* axle from which they wrap themselves on the metal wire which comes slowly forward.

In order that the cylinder, *i i′*, may take wires of different sizes, the iron ring which holds the upper cylinder is united to the fixed part of the machine. This cylinder can within certain limits be moved away from the lower one, *i*, whilst the spring, *r*, always presses upon it. Whenever this adjustment is not sufficient for wires which are too thick or too slender, the cylinders may be substituted by others.

FIG. 15.

FIG. 17.

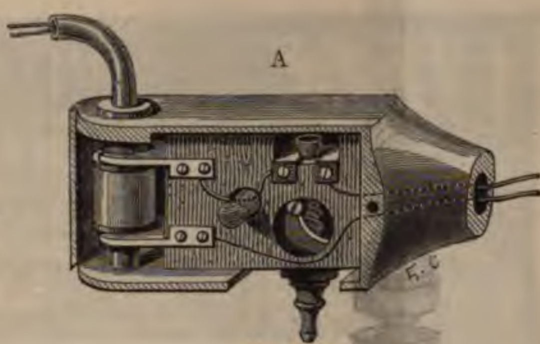


FIG. 16.

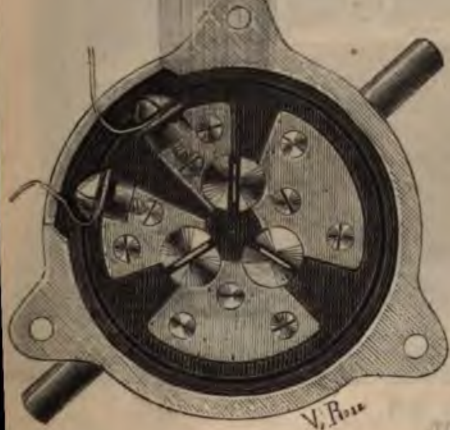


FIG. 20.

FIG. 19.

EDISON'S EXHIBIT.

FIG. 18.

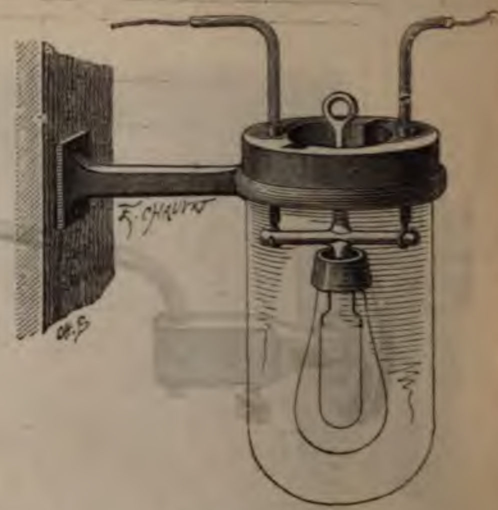


FIG. 21.

FIG. 22.

FIG. 23.

EDISON'S EXHIBIT.

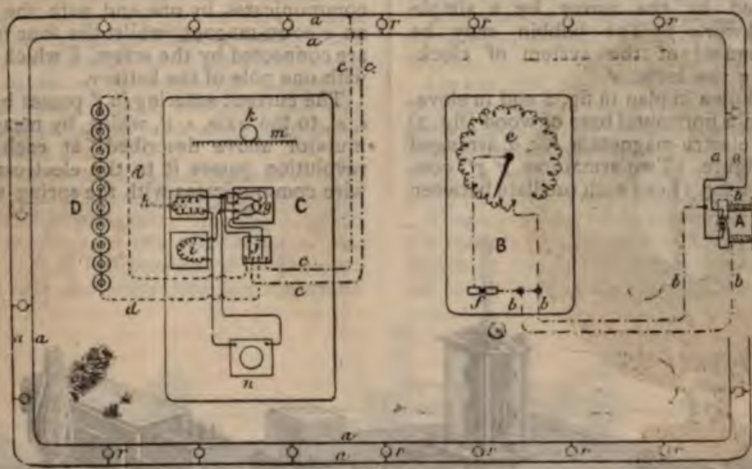


Fig. 25.

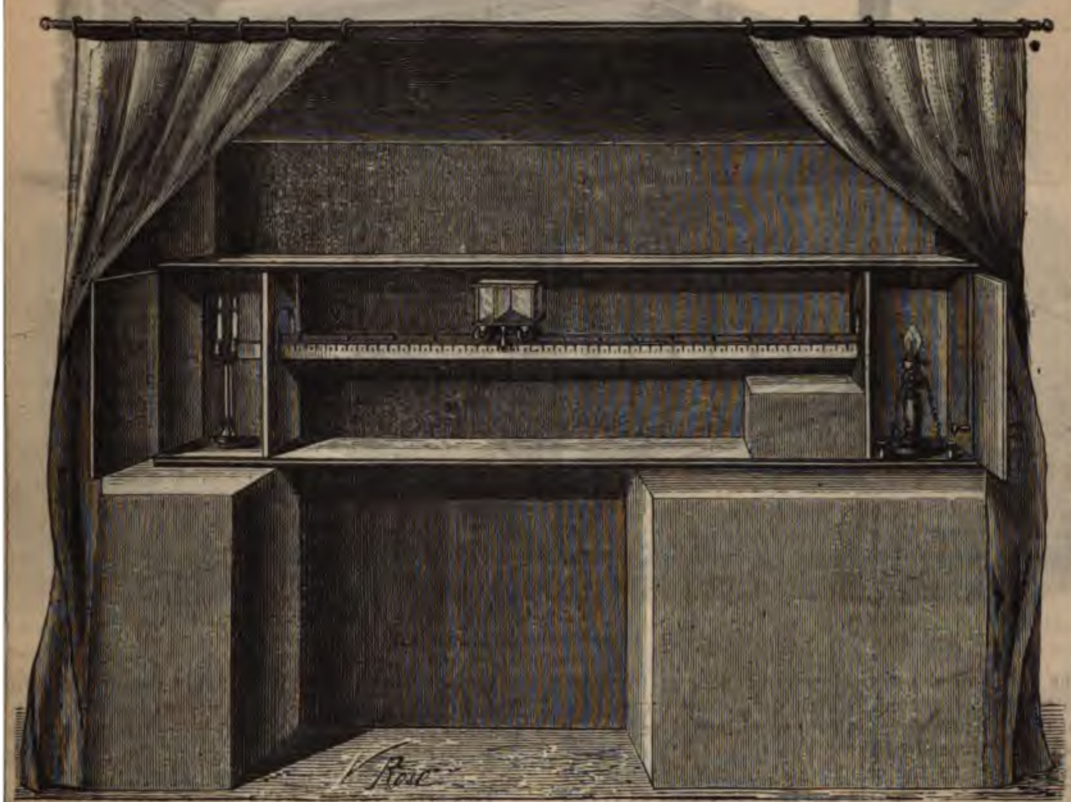


FIG. 26.—EDISON'S EXHIBIT.

The wire thus covered coils itself upon a large bobbin, R, which always tends to revolve in the direction indicated by the arrow by a simple system of clockwork. The bobbin may be rendered independent of the system of clockwork by lowering the lever, *d*.

The motor is shown in plan in fig. 2 and in elevation in fig. 3. On a horizontal base of wood (fig. 2) are fixed the four electro-magnets, *a*, *b*, *c*, *d*, arranged as shown in the figure. Two armatures, *g* g^1, connected below (in *n*, fig. 3) can each oscillate between planes, so that they may come in contact respectively with the four springs, *n*, *n'*, *n''*, *n'''*, each of which communicates by one end with the helix, forming an electro-magnet, whilst the four free extremities are connected by the screw, *l*, which communicates with one pole of the battery.

The current entering in *l* passes by the supports, *e*, *e'*, to the axle, *s*, *s'*, which, by means of the commutator above described, at each quarter of a revolution passes it to the electro-magnet, whose wire communicates with the spring touched by the

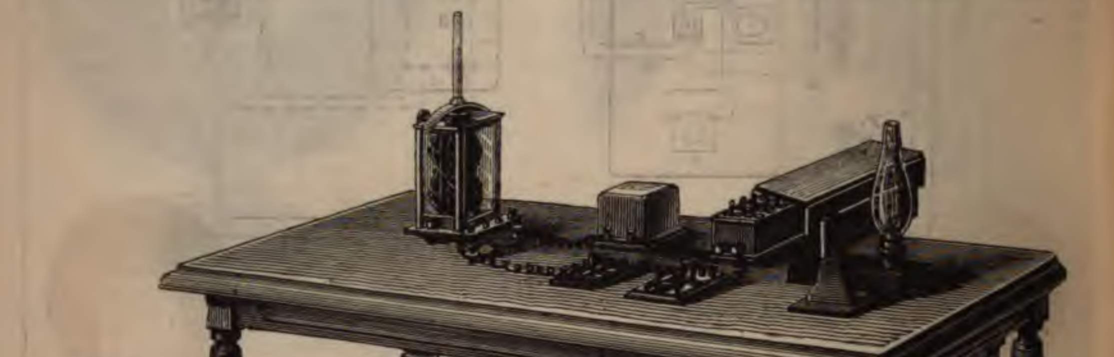


FIG. 24.—EDISON'S EXHIBIT.

the poles of the two electro-magnets as they are alternately attracted. This oscillatory movement of the two armatures is converted into a revolving action by means of the connecting-rods, *i* *i'*, which are geared to the cranks, *s* *s'*, of the fly-wheel, V. The wheel, *r*, which is on the same axis as V, has three grooves of different diameters, on which can be fitted the driving cord for the transmission of the movement. The same axle carries the commutator, consisting of two projections soldered upon the axle *in two different vertical* directions, and in different corresponding projection, so that in a complete revolution of the axle, the current passes successively to the four electro-magnets, causing the two armatures, *g*, *g'*, to oscillate, and by means of the connecting rods, *i*, *i'*, to set the wheel, *s*, *s'*, in rotation.

This arrangement of the motor seems preferable to the one usually adopted, since it combines efficiency with simplicity. In fact, the current does not pass simultaneously into the different coils as in other motors of this kind, but passes successively and without any deviation in such a manner

that the electro-magnet acquires the maximum magnetic force. It will be easily understood how the above system may be adapted to three electro-magnets instead of four, arranged in three pairs. The axle will then be fitted with three springs, and the commutator will be formed of six springs and three projections, so as to convey the current to each coil at each sixth part of a revolution. By this arrangement greater power and more regularity would be obtained.

But the entire apparatus, as just described, does not satisfy the condition that it should work without requiring any supervision. It might easily happen that a breakage of the silk thread or the exhaustion of one of the bobbins should occur. In these cases it is necessary that the apparatus should stop automatically. This object is attained in the simplest manner by means of a mercurial interrupter, K (fig. 1). This is formed of an electro-magnet, *a*, which can draw down the lever, *m*, by attracting the armature fixed to it. The lever carries on its other arm two iron screws, *n*, *n'*, the ends of which plunge into two small cups of mercury; of these screws, *n* is always in contact, whilst the other comes into contact only when the lever is depressed. When the lever is in this latter position, the electric current before arriving at the motor passes through the two cups of mercury, as the apparatus is in action, until the circuit is closed by the metallic arch terminating in the two screws, but at the moment when it enters into action the electro-magnet, *a*, presses down the lever, *m*, on the side of the screw, *n'*, separating it from the mercury, with which it was in contact, and by breaking the circuit, brings the motor to a stand.

It remains to be shown how the current passes in the electro-magnet, *a*, when a thread of silk is broken.

On the disc, N, N', it will be seen that the thread of silk coming from the bobbin, *h*, after having passed through the orifice, *x*, enters first at *o* into another orifice made in the end of the rod, *n*, which when it is free, is pressed by a slender spring, always kept in contact with a metal disc, V.

There are four rods corresponding to the four silk threads (for the sake of clearness, only one is shown in the figure) which communicate through the entire body of the machine with one pole of the battery, whilst the disc, V, communicates with the other pole, including the electro-magnet, *a*, in the circuit.

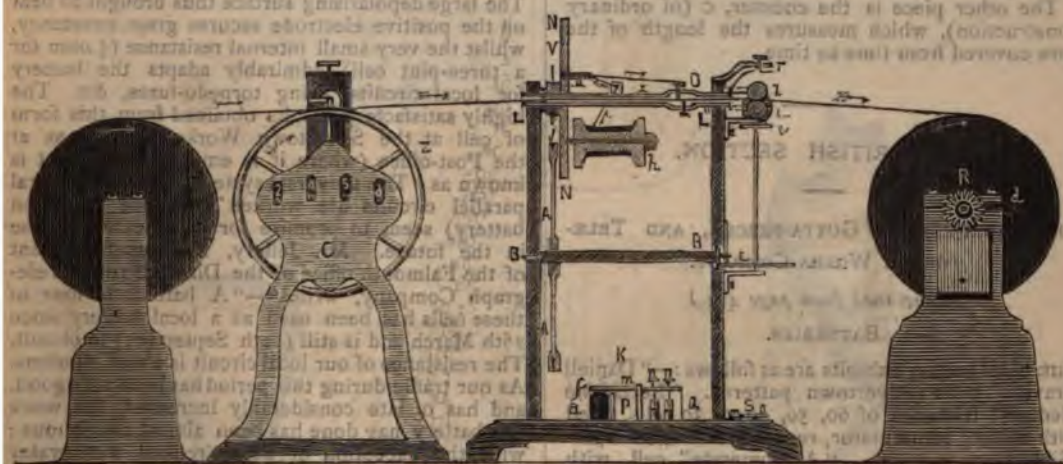


FIG. 1.

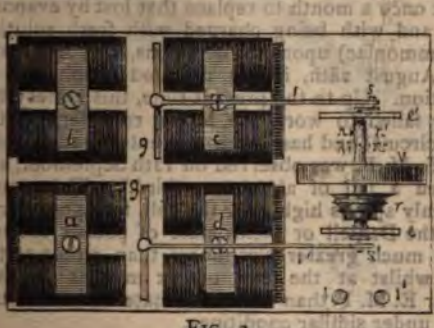


FIG. 2.

FIG. 3.

As long as all the silk threads pass through the rods, they are all drawn away from the metal disc, V, and therefore the circuit is interrupted; but if one of the threads fails and leaves its respective rod, the latter comes in contact with the metal disc, the circuit is closed, and the electro-magnet, *a*, exerts its action, and brings the motor to a stand.

In order that the circuit may remain open when the apparatus is not in use and thus the waste in the battery be stopped, a mercurial interrupter is included in the last circuit, and the lever, *m*, is placed in unstable equilibrium by means of a screw, *g*. Thus the electro-magnet, *a*, fulfilling its office,

interrupts the circuit simultaneously without turning the lever backwards.

To render the apparatus as complete as possible, two other pieces have been added which, though not indispensable, are of great advantage, especially when the machine has to work for a lengthened period.

The first of these is an electric bell, which is intended to give notice when a silk thread is broken, and that the machine has suspended its work. This is done by means of a little column, *p*, added to the interrupter, K, which plays the part of a commutator, and causes the current to pass from the motor to the bell; the latter will then sound until some one comes to open the circuit, which is done by means of an interrupter, *s*.

The other piece is the counter, C (of ordinary construction), which measures the length of the wire covered from time to time.

THE BRITISH SECTION.

THE INDIA-RUBBER, GUTTA-PERCHA, AND TELEGRAPH WORKS COMPANY.

(Continued from page 412.)

BATTERIES.

THE chief battery exhibits are as follows:—"Daniell Gravity" cells (Silvertown pattern). "Leclanché Medical" Batteries of 60, 50, 40, or 30 cells, fitted with battery commutator, reverser, and interrupter (Silvertown pattern). "Agglomerate" cell, with agglomerate blocks attached to the carbon plate and insulated from the zinc by india-rubber bands. "Round torpedo firing" cell, with felt diaphragm and circular zinc—used for firing spar torpedoes, with safety plunger contact; the zinc plates in this battery are $14\frac{3}{4}$ inch × $4\frac{3}{4}$ inch, and the carbon electrode $7 \times 4\frac{1}{2}$ inches, the latter being in a felt bag containing grain carbon and peroxide of manganese. "Ship" battery—zinc plate $35\frac{1}{2} \times 9$ inches; the carbon electrode consists of four carbon plates coupled together and inclosed in a felt bag containing grain carbon and peroxide of manganese. One of these cells is said to be capable of firing a broadside of twenty-four guns. "Six rod agglomerate" cell (Silvertown pattern). This latest new form of Leclanché cell, now being made in large numbers at the Silvertown works, is deserving of special notice. The favour which the Leclanché battery has met with on account of its high electromotive force, easy management, and cleanliness has hitherto been somewhat modified owing to its want of constancy. Under the influence of the current the peroxide of manganese is reduced to the sesquioxide, causing an increase in resistance, and the evolution of ammonia in considerable quantity is an additional element in reducing its constancy. An important improvement was no doubt effected in the earlier form by employing what are known as "agglomerate" plates, which obviate the use of porous pots, thereby decreasing the internal resistance of the battery and rendering the depolarising agent more effectual. But even with this improved form, experiment shows that when working through low resistances the electromotive force of the battery rapidly diminishes, though it recovers rapidly when the latter is inactive; it is in this polarising tendency that a very material improvement has been effected by the latest form given to the cell. The positive electrode consists of a fluted carbon rod having grooves of a rather smaller diameter than that of the agglomerate rods; six of these rods surround the centre rod and are held in close contact with it by india-rubber bands, so that the small spaces between the two facilitate the circulation of the liquid and the dissipation of the gas evolved; a coarse canvas bag prevents contact between the agglomerate rods and a circular zinc. The large depolarising surface thus brought to bear on the positive electrode secures great constancy, whilst the very small internal resistance ($\frac{1}{5}$ ohm for a three-pint cell) admirably adapts the battery for local circuits, firing torpedo-fuzes, &c. The highly satisfactory results obtained from this form of cell at the Silvertown Works, as well as at the Post-office (where it is employed for what is known as "The universal system," in which several parallel circuits are worked from one common battery) seem to promise for it an extended use in the future. Mr. Jeffery, the superintendent of the Falmouth office of the Direct Spanish Telegraph Company, writes:—"A battery of four of these cells has been used as a local battery since 26th March and is still (12th September) in circuit. The resistance of our local circuit is about 70 ohms. As our traffic during this period has been very good, and has of late considerably increased, the work this battery has done has been almost continuous; with the exception of being refilled with water about once a month to replace that lost by evaporation, and with being charged with fresh solution (sal ammoniac) upon two occasions, viz., July 10th, and August 28th, it has required absolutely no attention. Up to the present time, this battery has never failed to work the Morse recorder (on the local circuit) and has given me entire satisfaction. The E. M. F. was observed on 12th September, and showed a fall of about one-third." This result certainly speaks highly for the cell, for as compared with the Daniell or bichromate of potash battery, it has much greater cleanliness than either of the two, whilst at the end of six months it has a higher E. M. F. than the bichromate element could show under similar conditions.

TORPEDO APPARATUS.

The exhibit of torpedo apparatus is very interesting, and is as follows:—

Pair of "Telescopic firing arcs," for firing and converging stations, fitted with telescope, vernier, *sights* with platinum contacts attached, contact rod, spirit level, and levelling screws.

A "Seven shutter signalling and firing" instrument, consisting of automatic relay for switching the torpedo cable from the *signalling* to the *firing* battery, a shutter to indicate the number of the mine exploded, and bell to attract the attention of the operator.

"Mathieson's improved circuit closer"—used in connection with the *electro-contact system*—with

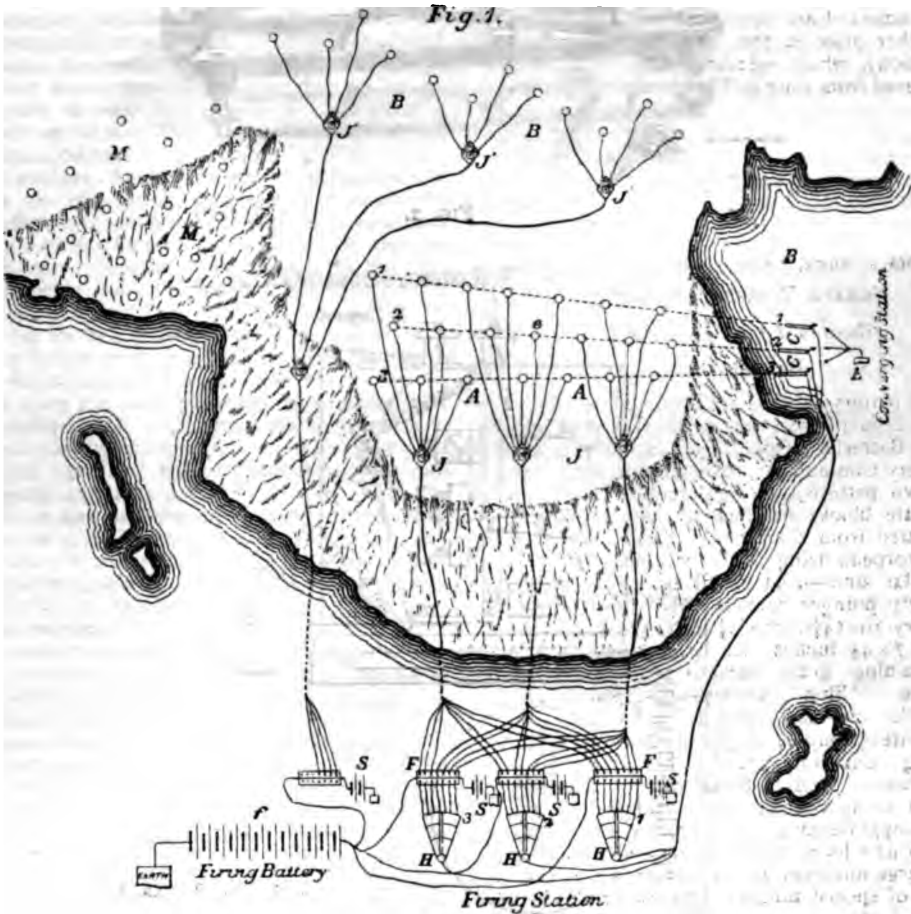
coiled tapering spring. When set vibrating by the concussion of a passing vessel, this instrument gives a succession of contacts, each of which completes the torpedo circuit.

"Torpedo testing table," fitted with astatic detecter, a three-coil galvanometer, key, commutator, Wheatstone bridge, set of resistance coils, and clip for holding a definite length of platinum wire.

The remarkable development during the last few years in the science of submarine warfare, and the important *rôle* which it seems destined to play in the maritime wars of the future, induces us to enter shutter *signalling and firing instrument*, F, for each group of mines, and a speaking instrument to communicate with the converging station, B. At the latter there are, in addition to the speaking apparatus, three converging arcs, C, C, and keys, one for each *line* of mines. A four-core cable connects the two stations, one conductor being required for each line of mines and the fourth (not shown in the figure) for telegraphing purposes.

There are three groups, A, A, each consisting of seven torpedoes, moored in three lines, converging, as shown, to the arcs, C, C, at station B. Single core cables connect these mines at the junction boxes,

Fig. 1.



somewhat fully into the existing electric torpedo systems, as it is a subject of considerable interest, and one to which the attention of many of our readers has perhaps been little directed.

Firing Torpedoes by Observation.

Fig. 1 is a sketch of an imaginary harbour, defended by submarine mines. A and B are, respectively, the *firing* and *converging* stations. The firing station is provided with the battery necessary to explode a mine, a firing arc, H, and key, a J, J, with the three seven-core cables communicating with the firing station. To simplify the arrangement on shore, the conductors are so joined up that each *line* of mines communicates with a separate *signalling and firing apparatus* and its telescopic firing arc.

The *firing arc*, fig. 2, consists of a cast-iron frame, *x*, with levelling screws and spirit level, and is fitted with a telescope, T, capable of vertical and horizontal movements, and also of being raised and lowered by a rack and pinion motion. The

telescope is provided with cross wires, and carries a vernier, v, which follows every horizontal movement of the telescope, and traverses a graduated scale. A clamp screw is also provided to fix the telescope in any required position. On the outer arc of the frame are *sights*, *s*, with metallic V-contacts, *k*, attached to, but insulated from, the rest of the instrument. The position of these *sights* and corresponding to the several mines. This movable rod is insulated from the framework and put in connection, through a contact key, with the cable leading to the corresponding arc at the converging station. The *converging arc* has also a telescope, the *sight* being very carefully adjusted so that the axis of the telescope passes through its particular line of torpedoes. The operator at this station is

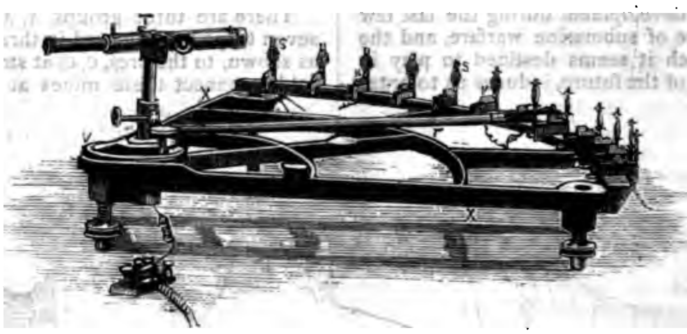


FIG. 2.

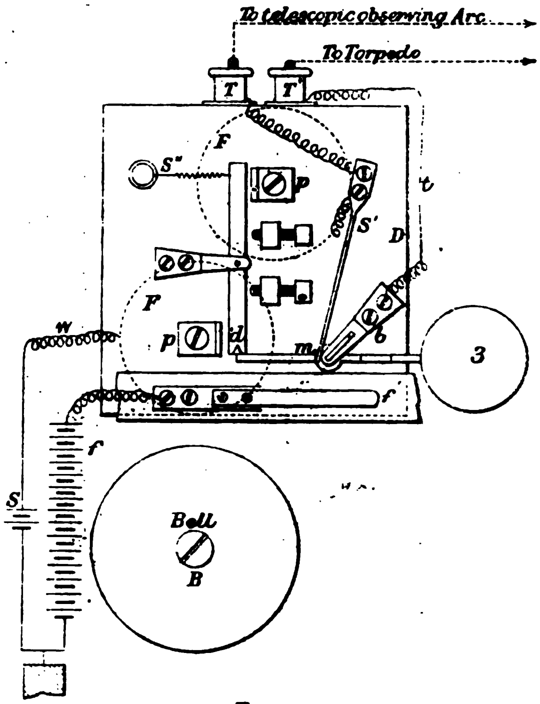


FIG. 4.

their metallic contacts on the arc are made to correspond with the bearings of their respective mines, as fixed by careful telescopic observation, when the torpedoes are first moored; each sight is, moreover, labelled, to indicate the number of the mine. Rigidly connected to the upright which carries the telescope, and moving with it, is a brass rod, *r*, at the end of which is a spring contact, *which passes over* and rubs against the V-contacts, provided with a key by which he can put the cable leading to the corresponding firing arc to earth at will.

The Shutter *Signalling and Firing Instrument*, fig. 4, is in principle an automatic relay for switching the firing battery, *f*, into circuit and showing the number of an exploded mine, so that any breach in the line of defence is indicated. In the present instance, each instrument, of which there are three,

consists of seven relays in one case, *i.e.*, one for each torpedo in one of the three converging lines of mines. Its construction is as follows: Secured to an electro-magnet, F F, is an ebonite plate, D, through which the soft iron poles, *p p*, protrude. Between these poles is the armature, pivoted at its centre, and held back, when not influenced by a current, by a light spring, *s''*, and limited in its movement by screws. A detent, *d*, at the lower end of the armature, presses against the end of a pendulous lever which is pivoted near its centre in the bearings, *b*, and has at its other extremity a metallic disc, or shutter, 3. A spring, *s'* (connected with one end of the electro-magnet coils and the terminal to which one of the contacts on the telescopic observing arc is attached) presses against a platinum tongue, *m*, on the pinion of the lever, so long as the latter remains in a horizontal position. But as soon as the current passes from the weak *signalling battery*, *s* (generally of only two cells), the armature is attracted and releases the lever, when the disc, 3, falls, breaks contact with spring, *s'*, attracts attention by striking the bell, B, and at the same time engages the clip-spring, *f*[1], in doing which the firing-battery, *f* (one pole of which is to earth), is switched into the torpedo cable circuit, T, and the mine exploded. Moreover, the number on the disc, when the lever is in a vertical position, shows which mine has been fired.

In order to bring the above action about, it is necessary to put earth on at the terminal leading to the telescopic observing arc, T, and this is done by *both* the *firing* and *converging* stations pressing their keys simultaneously; for, since the earth plate, E, is at the *converging* station, it is only by their joint action that the firing battery can be switched into the torpedo circuit.

It will be seen on referring to the connections in fig. 4, that if a *good* earth be made in the torpedo cable circuit the same result will follow. This is what actually happens when a *circuit closer* is employed in connection with a torpedo, as will presently be described.

Let us take the case of an enemy's ship approaching the first line of torpedoes. The operator at the firing arc, 1, who controls the whole advanced line of torpedoes, follows carefully the movements of the vessel by turning his telescope from one fixed sight to another, as the vessel changes position, closing at the same time the V-contact, corresponding to the sight at which the telescope rests, by means of the contact rod, *r*, and pressing down his key as long as the vessel is within striking distance. Meanwhile, the observer at the converging arc, 1, waits till the vessel is crossing his *line*, and only keeps his key down so long as the vessel is covered; directly she has passed the line he opens his key. If while the vessel crosses B's first line the operator at A cannot cover her with any of his sights, he does not close his key, because the ship is evidently passing between two torpedoes and on to the second line of mines. The same operation is then gone through between firing and converging arcs No. 2, and only when the vessel is passing over a spot where the lines of a sight on the firing and corresponding converging arc intersect each other will both keys be down and the torpedo exploded. Suppose the ship to have passed the first line and be crossing torpedo marked *e* in the second line, in order to fire that mine the operator at firing arc, 2, will have his telescope on his middle sight and his key down, while the operator at station, B, will simultaneously be pressing the key corresponding to his telescope which commands the middle line of mines. In this case the current from the signalling battery, S, passes through the coils of the signalling and firing instrument, F, to terminal, T, to contact of firing arc, 2 (corresponding to torpedo, *e*), then to conductor of cable connecting firing arc, 2, with converging arc, 2, and thence by key to earth. The result is that the armature, *p*, *p*, is attracted, and trips the lever so that the disc falls, breaks contact between the tongue, *m*, and the spring, *s*[1], switches in the firing battery (usually of 100 cells Leclanché), and allows the current to pass from spring, *f*[1], through lever of shutter, bearings, *b*, and so by torpedo terminal, T[1], to explode the mine. On referring to the figure it will be seen that so long as the lever of the signalling and firing instrument is in its normal horizontal position, the terminals, T and T[1], are virtually one, being in metallic connection through the spring, S[1], hence a circuit closer floating above the torpedo (fig. 9), and operated by the concussion of a pass-

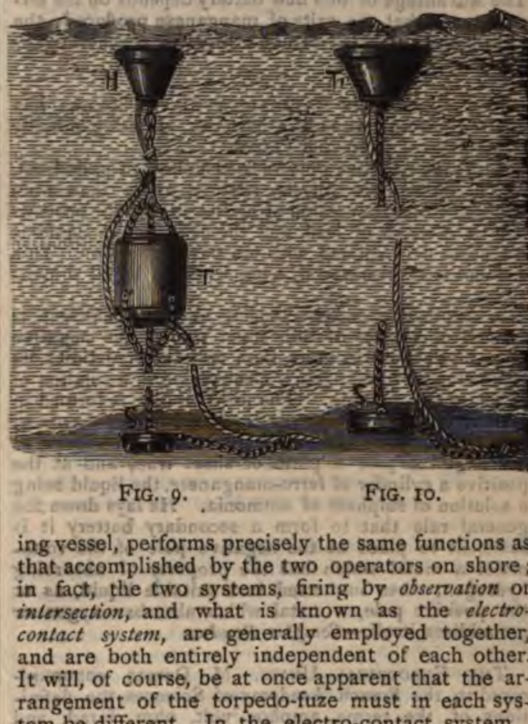


FIG. 9. FIG. 10.

ing vessel, performs precisely the same functions as that accomplished by the two operators on shore; in fact, the two systems, firing by *observation* or *intersection*, and what is known as the *electro-contact system*, are generally employed together, and are both entirely independent of each other. It will, of course, be at once apparent that the arrangement of the torpedo-fuze must in each system be different. In the electro-contact system platinum wire fuze is used, which has a comparaa tively small resistance, so that when a ship strikes the *circuit-closer* and puts earth on, the signalling battery of two cells is ample to work the signal and firing instrument; whereas, when firing by *observation* a high tension fuze or some electro-magnetic switch arrangement in connection with a separate platinum fuze is employed, with a resistance too high for the signalling battery to work through effectually, but which is readily made to fulfil its function by the heavy firing battery. The

electro-contact system is clearly practicable by day or night, while firing by observation is limited to clear weather; but, on the other hand, the electro-contact system, to be operative, requires that a vessel actually strike the *circuit-closer*, and taking into consideration that torpedoes have to be moored a considerable distance apart so that the bursting of one may not explode its neighbour, a breach in the line of obstruction would necessarily reduce the chance of a ship coming into collision with an electro-contact mine, whereas it might easily pass near enough, if not to be destroyed, at any rate to be disabled by torpedoes fired by observation, so that the one system is a powerful auxiliary to the other.

(*To be continued.*)

Notes.

A NEW BATTERY.—M. J. Rousse proposes to substitute ferro-manganese for the zinc in the Bunsen element. A battery thus constructed has the same electromotive energy as one with amalgamated zinc. The advantage of this new battery depends on the circumstance that the salts of manganese produced—the nitrate and sulphate—can be utilised or regenerated.—*Comptes Rendus.*

NEW SECONDARY BATTERIES.—M. J. Rousse has devised several secondary batteries, differing notably from those of Faure and Planté.

1. At the negative pole he uses a sheet of palladium, which, during electrolysis, absorbs more than nine hundred times its volume of hydrogen. At the positive pole is a sheet of lead, and the electrolysed liquid is sulphuric acid diluted with ten parts of water. This element is very powerful, even when of small dimensions.

2. Another secondary element, also very efficient, is formed of a plate of thin sheet iron at the negative pole, which absorbs more than two hundred times its own volume of hydrogen, if electrolysed in a solution of sulphate of ammonia. The positive pole is formed of a sheet of lead, which may be coated with litharge or white lead. The author has also used with success at the negative pole a plate of sheet iron, and at the positive a cylinder of ferro-manganese, the liquid being a solution of sulphate of ammonia. He lays down the general rule that to form a secondary battery it is sufficient to place at the negative pole of the voltameter a metal which has the property of absorbing hydrogen, when immersed in a suitable liquid, as at the positive pole, a metal which absorbs oxygen or peroxidises itself.—*Comptes Rendus.*

THE ELECTRICAL UNITS.—M. Dumas communicated to the French Academy of Sciences the definitions of the terms, ampère, volt, ohm, farad, and coulomb, as formally adopted at the recent Congress of Electricians.—*Comptes Rendus.*

STEEL MELTING BY ELECTRICITY.—M. Dumas also described the remarkable results of an experiment performed by M. C. W. Siemens, in the Palais de l'Industrie. Several kilos of steel were melted by the electric current in a crucible of magnesia. The fusion, effected in fourteen minutes, merely requires that an electro-dynamic machine should be set in motion at an outlay in fuel less than would have been required for direct fusion in an ordinary furnace.

TELEPHONE EXPERIMENTS IN SYDNEY.—The *Sydney Mining Herald* reports some experiments which have been made by the representatives of the Crossley Telephone Company, of London, between Melbourne and Albury, a distance of 200 miles, and between Sydney and Parramatta "with the most satisfactory result, the conversation carried on between these places being as distinct as that of two persons in the same room."

THE WHEATSTONE FAST-SPEED APPARATUS.—We understand that the Western Union Telegraph Company (America) have given an order for 12 complete sets of the Wheatstone automatic fast-speed apparatus to be sent out from England, the intention being to work the same on the company's lines. As the Wheatstone instrument does not profess to work at the extreme high speed which is claimed for more than one transatlantic apparatus, it is somewhat significant that its employment should be determined on.

THE S. S. HOOPER.—The telegraph s.s. *Hooper* has been bought by the India-Rubber, Gutta-Percha and Telegraph Works Company. The ship, which is to be renamed the *Silvertown*, is the largest cable ship afloat. Her measurements are:—Length over all, 350ft.; beam, 55ft.; moulded depth, 36ft.; gross tonnage, 4,935 tons; net register, 3,724 tons. She has three cable tanks, each 30ft. deep, and having respectively the diameters 41ft., 53ft., and 51ft., with the usual cable gear. The ship leaves England in March to assist in laying the 3,000 miles of cable now being manufactured by the company for the west coast of South America.

ON the 14th and 23rd ult. gales of unusual violence swept over the United Kingdom, doing much damage to the telegraph plant throughout the country. From reports received, it appears that the major portion of the damage to the land lines was caused by the falling on the wires of uprooted timber, and that to the submarine lines by the anchors of drifting vessels. The east coast of Scotland has perhaps suffered most in this respect; the two cables in the Firth of Forth, connecting Granton with Burnt Island, being broken, and communication between these points being completely interrupted.

THE JERSEY CABLE.—The recent interruption in the Jersey cable appears to have been caused by a somewhat unusual kind of fault. The cable parted near the shore; but instead of an "earth" fault being caused thereby, the gutta-percha closed over the broken end and sealed up the break, thus producing a "disconnection."

A MYSTERIOUS DOCUMENT.—In 1783 the French Academy of Sciences was called upon to examine an invention which seems to have anticipated in some way the electric telegraph. It was stated that by its means a message could be transmitted in a few seconds over a distance of 30 leagues without intermediate station. Condorcet, the reporter for the commission of examination, stated that the system was ingenious and practicable. In order to insure the rights of the inventor, a sealed packet containing the details was deposited with the Academy. M. Aglave has written to inquire whether this packet ought not to be searched for in the archives of the Academy, and to suggest that now that a century has almost passed since it was deposited, the rights and wishes of the inventor would not be outraged if it were to be opened. The administrative council of the Academy have been instructed to give the matter their attention.—*Mechanical World.*

THE PARIS EXHIBITION.—It has been decided that the Paris Exhibition is to close on the 17th of the present month.

THE SHETLAND CABLE.—On the evening of the 26th ult. telegraphic communication between the mainland and Shetland was restored after an interruption of upwards of six months.

UNDERGROUND TELEGRAPHS IN GERMANY.—The system of underground telegraphy devised by Dr. Stephan, Postmaster-General of Germany, is now completed. On the 14th of March 1876, the first line of cable from Berlin to Halle was commenced, and on the 26th of June, 1881, the system was completed by laying the cable from Cologne to Aix-la-Chapelle. In eighteen months eighteen lines have been laid, comprising, according to the *Algemeiner Anzeiger*, 3,394 miles of cable, costing 30,200,000 marks (£1,510,000). The 18 lines connect 221 towns, including the most important places of commerce and chief fortifications of the German Empire. The conductors in the 3,394 miles of cable have a total length of 23,213 miles. The weight of the materials consumed in manufacturing these cables was 12,825 tons, consisting of 10,165 tons of iron, 823 tons of copper, 837 tons of gutta-percha and hemp, and 383 tons of asphalte. In the crossing of rivers 70 cables were required.

DANGEROUS TELEPHONE WIRES AND UNDERGROUND LINES.—An inquest has been held in Birmingham on the body of James Trueman, who was killed by the fall of a chimney stack during the recent gale. It was stated that a wire belonging to the British and Irish Telephone and Electric Works Company was fixed to the chimney in question, and that the wire broke near to the stack. A builder was of opinion that if the wire had not broken, or if it had never been attached to the chimney, the stack would not have fallen. The jury returned a verdict of death by misadventure, but added that in their opinion it was dangerous to the public safety to fix wires to chimney stacks, that they were surprised that the Corporation allowed the wires to be so fixed without proper supervision, and that the only safe course to adopt was to carry such wires underground.

THE SOCIETY OF ARTS.—The following are among the papers announced to be read during the next session of the Society of Arts: "Telephonic Communication," by Lieut.-Col. C. E. Webber, R.E.; "The Storage of Electricity," by Prof. Sylvanus Thompson, D.Sc.; "The Distribution of Time by a System of Pneumatic Clocks," by J. A. Berly, C.E. The usual short course of juvenile lectures, given during the Christmas holidays, will be by Mr. W. H. Preece, F.R.S., the subject being "Recent Wonders of Electricity." The following papers, which indirectly bear more or less on the electric light question, will also be read: "The Production and Use of Gas for Purposes of Heating and Motive Power,' by J. Emerson Dowson; "Gas for Lighthouses," by John Wigham (illustrated by an exhibition of some of the gas flames and apparatus used in lighthouses).

THE ELECTRIC LIGHT BY TIDAL POWER.—At a recent meeting of the Bristol Town Council, a proposition was submitted to utilise the rise and fall of the tide on the Avon as a motive power in connection with illuminating the city by the electric light, but it was stated that a committee had been investigating the merits of the various systems, and that they considered it desirable to wait their further development.

JOHNSON'S CARBON TELEPHONIC TRANSMITTER.—The Preston Board of Guardians have selected Mr. Johnson's carbon transmitter for the line of telephonic communication which it is intended to establish between Fulwood workhouse and the Union offices. This instrument was tested against the Blake, and also the Gower transmitter, and found, it is stated, to be superior to both.

THE ELECTRIC LIGHT AT CHESTERFIELD.—In consequence of the success of the experiments made in lighting the streets of Chesterfield by the electric light, the Watch and Lighting Committee have made an arrangement for the lighting of the town for one year for a sum less than that paid per year to the gas company by a considerable amount.

THE ELECTRIC LIGHT IN CANADA.—The engineer of Ottawa has reported against the proposal to light the city by electricity. The present cost of doing so by gas is stated to be £2,546. Electricity generated by steam would cost £4,960, and, if water power were utilised, £3,200.

THE ELECTRIC LIGHT IN TURKISH LIGHTHOUSES.—The Turkish Government is at present studying the question of electric lighting of the lighthouses along Turkish coasts. A Frenchman, M. Michel, has been charged with the erection of the new lighthouses projected on the shores of the Red Sea. An international commission has met at Constantinople to fix the tariff of those lighthouses, which are greatly required for navigation.

INFLUENCE OF ELECTRICITY ON THE GROWTH OF THE VINE.—M. Macagno, in *Les Mondes*, states that he has been making experiments on the influence of electricity upon the growth of the vine. An electric circuit was formed by copper wire between the extremity of a branch bearing fruit and its origin near the soil. More wood was formed in the branch, which contained less potash than the other parts, and the grapes ripened more readily, containing an excess of sugar.

THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.—At the first meeting of the session, commencing on Thursday, November 10th, Mr. John Alexander Lund will read a paper on the system of synchronising clocks adopted in London and elsewhere, with an exhibit of a complete set of all the various instruments connected with its working.

ANOTHER APPLICATION OF ELECTRICITY.—The newspapers mention that "what is supposed to be an infernal machine of rude construction has been found on the roof of the Masonic Hall at Dingwall. It is inclosed in a small wooden box, and contains a roughly modelled electric apparatus and a quantity of dynamite or other explosive substance. It has apparently been constructed by some person acquainted with electricity.

ELECTRIC COMMUNICATION WITH LIGHTHOUSES.—The Lord Mayor, M.P., has received the following letter from the Prime Minister:—"10, Downing Street, Whitehall, Oct. 31.—My Lord Mayor,—I have had the honour to receive from you a copy of resolutions passed by a meeting held at the Mansion House with respect to telegraphic communication between lighthouses and lightships and the shore, and have at once forwarded them for consideration to the Board of Trade.—I have the honour to be, my Lord Mayor, your most faithful and obedient servant, W. E. Gladstone."

TELEPHONIC.—Threatening notices having been sent by the United Telephone Company to the subscribers to the Plymouth Exchange, counter-action has been commenced by Mr. Pope Cox, the proprietor, who lays his damages at (we hear) £10,000. In reference to this matter the Post Master General advertises that he has at present licensed no other exchange than that worked by Mr. Cox.

THE Lancashire and Cheshire Telephone Company (provincial branch of the United Company of London) has purchased the business of Messrs. Moseley and Sons of Manchester, and, we are informed, has appointed Mr. Moseley manager. (Another sale effected !)

THERE is in course of formation, amongst those interested in telephonic inventions other than Bell's or Edison's, a syndicate for mutual defence in "Telephone Infringement" law-suits. Something of this kind was attempted some time ago, but so long as the United Company can find the money wherewith to buy, unity in defence amongst those who are *indifferent* whether their money is made alone or in company (so long as it is made) is almost an impossibility. Most men will take what they considers their price and—clear out.

New Patents—1881.

4654. "Lighting by gas and electricity combined." R. H. COURTENAY. Dated October 25.

4664. "Electrometers." J. IMRAY. (Communicated by J. C. Carpentier.) Dated October 25.

4670. "Improvements in metallic pillar posts and columns for telegraphic and other purposes and in the machinery employed to produce the same." R. B. LEE. Dated October 25.

4694. "Apparatus for actuating signalling apparatus on railways by means of electricity." E. EDWARDS. (Communicated by E. Lesbos.) Dated October 27.

4695. "Method and means for utilising electric-circuits for various purposes, such as telephonic and telegraphic communication, controlling or synchronising time measures, fire or burglar alarm systems, and the like." W. F. BARNETT. Dated October 27.

4748. "Galvanic or electric batteries." W. R. LAKE. (Communicated by J. F. Aymonnet.) Dated October 29.

4758. "Apparatus for the transmission of vocal and other sounds." F. J. SMITH. Dated October 31.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1881.

768. "Connecting the carbon ends to conducting wires in electric lamps." E. G. BREWER. (A communication from abroad by Thomas Alva Edison.) Dated Feb. 23. 6d. Consists in uniting the carbon to the wires in any suitable manner, and then electroplating the point of union, thereby making permanent the union and at the same time making perfect electrical contact between the carbon and the conductors.

879. "Electric light signalling." ARTHUR SHIPPEY. Dated March 1. 4d. Relates to improvements in electric light signalling, chiefly applicable for use at sea, for the purpose of assisting in the saving of life, also for signalling for military and other purposes. A balloon or kite has suspended from it an apparatus provided with an electric light lamp. When it is required to give a signal the balloon or kite is allowed to ascend to the required height, which may be regulated by the quantity of cord or wire unwound from a windlass. The wire or cord is then connected with the battery or other generator of electricity so as to produce an electric light in the lamp.

894. "Electric lamps." J. J. SACHS. Dated March 2. 6d. Relates to improvements in electric lamps. The two carbons are placed in tubes arranged side by side, either vertically or at an angle, with the bottoms of the carbons resting upon a plate or upon the side of a body of a globular or other suitable shape, such plate or body being composed of asbestos, porcelain, or other suitable material. At the point of contact of the carbons with the plate or body, the latter may be perforated so as to admit of the emission of the light whilst preventing the carbons from passing through. As the carbons wear, they descend by gravitation, assisted if necessary by a weight or spring, and are thus always maintained in contact with the plate or body so as to insure constancy and uniformity in the light.

918. "Producing audible signals on railways by electricity." E. TYER. Dated March 3. 8d. Relates to means for giving audible signals which may serve in lieu of the usual signals when these are obscured, or which may be employed along with the visible signals as additional means of securing the driver's attention. For this purpose at the distant signal, or preferably at some distance in advance of it, a gong or bell is mounted, having its hammer worked by the armature of an electro-magnet, the coil of which is intermittently excited by electrical currents transmitted from a battery. These electrical currents are intermitted by means of a rotating commutator caused to revolve by clockwork, which clockwork is kept wound up so as to be ready to start when required; for the purpose of starting it, an electrical contact apparatus is arranged at the side of the rail at a point some distance in advance of the gong or bell, so that on a train passing this point it, by depressing a trigger or by causing deflection of a rail, effects the required contact.

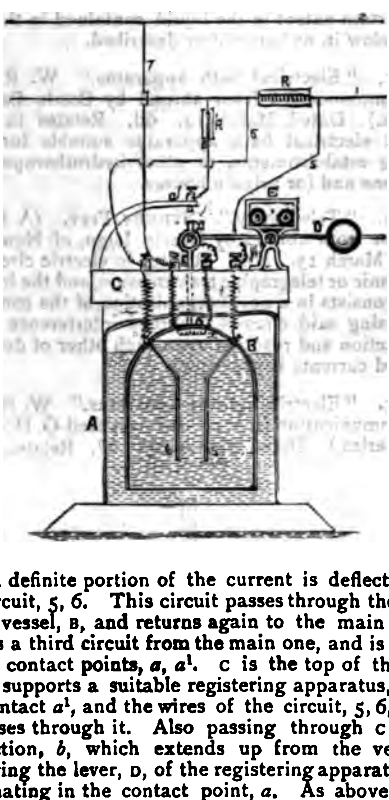
925. "Telephone transmitters." C. MOSELY. Dated March 4. 6d. Relates to the construction of apparatus for transmitting sound by the aid of electricity, and having for their object the reduction in the amount of electrical resistance in the transmitter and the attainment of an increased intensity of sound in the receiving instrument, and consist in the employment of precipitated sulphide of copper in a loose form or consolidated by pressure.

977. "Electric and automatic signalling apparatus." ERNEST DE PASS. (A communication from abroad by Hippolyte Leblanc and Eugène Victor Achille Loiseau, both of Paris.) Dated March 8. 6d. Consists in the combination of various apparatus, which together serve as a novel means for electric and automatic signalling for operating the signal discs on railways, and especially those discs on Leblanc's system.

991. "Galvanic batteries." GEORGE F. REDFERN. (A communication from abroad by Siegfried Marcus, of Vienna.) Dated March 8. 6d. Relates to improvements in galvanic batteries, equally applicable for military as for domestic purposes. The improvements also relate to the general arrangement of the parts forming the battery, particularly to the construction and employment of what may be termed a permanent element, and of a device whereby the usual earthenware porous pots now generally employed are not required. (*Provisional only.*)

1016. "Veber-meters." E. G. BREWER. (A communication from abroad by Thomas Elva Edison.) Dated March 9. 6d. Relates to apparatus for measuring an electric current. One part of the invention for this purpose consists in deflecting a definite proportional part of the current to be measured and

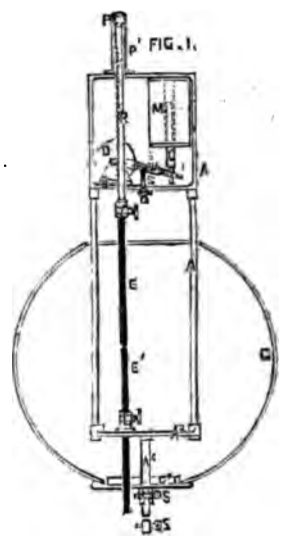
passing it through a vessel partially filled with water and floating in the same liquid. The water in the vessel is decomposed by the current, and the gases formed displace a portion of the water in the vessel, lessening its specific gravity and causing it to rise. The rising of the vessel causes the lifting of a lever connected with a registering mechanism, so that the amount of gases produced being proportional to the current passing through the vessel, and this in turn proportional to the main current, the last may be indicated by the register. Such arrangement is made that when a definite predetermined amount of decomposition has taken place the vessel will rise to a sufficient height to close an electrical circuit, which will send a current through the gases and explode them, so that they will be re-composed into water and the vessel again fall. These operations being repeated so long as current passes. Figure 1 is a view of an apparatus for this purpose; A is a tank of water, and B a vessel also containing water floating therin; 1, 2, is the main circuit from which, by means of the resistance placed



at R, a definite portion of the current is deflected into the circuit, 5, 6. This circuit passes through the water in the vessel, B, and returns again to the main circuit. 7, 8, is a third circuit from the main one, and is broken at the contact points, a, a^1. C is the top of the tank, A. It supports a suitable registering apparatus, E, and the contact a^1, and the wires of the circuit, 5, 6, and 7, 8, passes through it. Also passing through C is the projection, b, which extends up from the vessel, B, operating the lever, D, of the registering apparatus, and terminating in the contact point, a. As above stated, in consequence of the resistance, R, a definite portion of the current is deflected from the main current into the wire, 5, and passes down through C into the vessel, B. The lower portion of this current, 5, 6, is completed by the water, and the current in passing through it decomposes a portion thereof, which rises in a gaseous form to the surface. As the upper portion of the vessel becomes filled with these gases, the specific gravity of the whole is lessened and the vessel rises, carrying with it the projection, b, and thus moving the lever, D, which operates the register. When the upper part of the vessel, B, is entirely filled with the gases it rises to such a height that the contact, a, will meet a^1, and close the circuit, 7, 8. A current of electricity immediately passes along this circuit heating the platinum coil, x, and causing by explosion the re-composition of the gases into water. The vessel, B, then falls to its former position, re-opening the circuit 7, 8, and the current again passes through the circuit, 5, 6. This operation is of course continually repeated. A resistance placed at R^1 prevents the passage of too large a current of electricity through the circuit, 7, 8. Another portion of this invention consists in an arrangement for measuring an electric current as follows:—An electric depositing cell has a metal lining which forms one of the electrodes thereof, being connected in any suitable manner with one of the leading wires. The other electrode is a piece of metal suspended within the cell by a spring, the stress of the spring being so adjusted that the metal piece will be sustained at the top of the cell when there is a minimum of deposition thereon, while the maximum of deposition will cause it to sink to the bottom. An index arm is attached to the metal piece and a scale provided in connection therewith, so that the amount of deposition will be visually indicated. The electrodes are also connected with a registering apparatus and circuit reversers which change the direction of the current through the cell, and consequently reverse the anode and the cathode, so the metal is first deposited on and then removed from the metal piece, causing it to rise and fall, so that the registering apparatus works whenever the circuit is reversed.

1027. "Electric lamps." J. A. BERLY. Dated March 10. 4d. Consists in hinging the movable electrode in the Jamin lamp by means of a spring instead of a pivot. (*Provisional only.*)

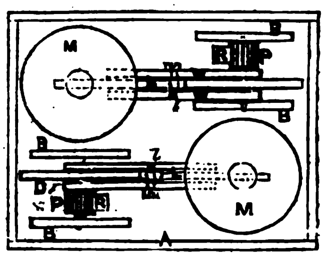
1040. "Electric lamps." A. A. COMMON and H. F. JOEL. Dated March 10. 6d. Relates to certain improvements in electric light arc lamps or regulators, and also to improvements in the construction of incandescent electric light lamps. The improvements in electric light arc lamps or regulators consists essen-



tially of a simple device and apparatus for striking and controlling the arc actuated by a solenoid, also of various devices for feeding and regulating the length of arc. Figure 1 shows a sectional elevation of a complete lamp, and figure 2 a plan of same. In the box or

frame, A, is mounted on bearings, B, a pinion, P, and large disc or wheel, D; into the pinion, P, is geared the rack, R, to which rack top electrode, E, is attached; on the other end of the rack, R, is a piston head, P, which almost fits into a cylinder, P^1, the said cylinder, P^1, being filled with glycerine or other fluid. As the rack, R, falls the glycerine must pass through the orifices

FIG. 2.



shown by dotted lines in P, and so retard and regulate the fall of R. On the axis of P are attached two weighted arms, W, between which arms a gripping lever, L, is pivotted at l; the said arms, W, rest upon the adjustable support, S. On the other side of the box is an electro-magnet solenoid coil, M, one part or section being wound with thick wire in the main circuit, the other part being wound with fine wire of suitable resistance and in reverse direction to the thick wire and connected to shunt across the arc as is well understood. In the centre of this coil is an iron core, C, he bottom end of this core, C, being connected loosely to the end of gripping lever, L. At the bottom of the lamp is shown the globe, G, the lower electrode E^1, the rames, A^1, A^2, A^3, and the globe holder, GA, with an arrangement, g, g^1, for lowering the globe. The action of this lamp is as follows:—When an electric current is sent through the thick wire coil of M, it passes through the carbons, E and E^1, and back to its source, the core, C, is sucked or drawn into the coil, M, and raises the lower end of the lever, L, causing the other end to move on the pivot, l, grip the disc D, at the point, l^1, and turn the pinion, P, this raises the rack, R, with the top carbon, E, attached and so strikes the arc. When the arc becomes too long the action of the thick wire coil on M is weakened and the shunt coil strengthened, the core, C, drops again, releasing the gripping lever, L, from D and allowing the rack, R, to fall; the above action is then repeated, and so on until all the carbon is consumed. The disc, D, may be milled on its edge if desired, and two sets of gear with two carbons may be used as shown in plan, figure 2, or two electro-magnetic solenoids arranged side by side, the essential features in this lamp being the transferring the large movement of the solenoid core to a fine movement of the carbon by means of the disc and gripping lever regulated by the current and feeding the carbon down as required.

1087. "Rotary hawse pipe for keeping submarine cables clear of the cable chains when the ship is swinging." T. COCKSHOTT and H. M. GOODMAN. Dated March 14. 4d. The invention consists of two rotating hawse pipes contained in one casting, and carried on friction rollers or other suitable bearings in flanges or framing fixed to the ship's bow. The hawse pipes consist of a larger and smaller one, the larger being concentric with the rotating casting and intended *for the ship's cable*, and the smaller one at one side, their axes being parallel. The revolving casting is rotated by means of a lever or levers inserted in one or other of a series of mortices on its periphery, or by spur or bevel gear or other suitable mechanical means.

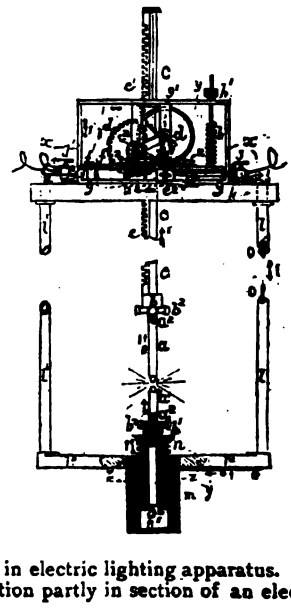
1094. "Automatic rapid telegraphy." B. J. B. MILLS. (A communication from abroad by W. A. Leggo, of Hartsdale, America.) Dated March 14. 8d. The object of this invention is to furnish a system of automatic rapid telegraphic transmission in which one machine may be used both for the preparation for transmission, and for the transmission of messages.

1097. "Voltaic batteries, &c." J. H. JOHNSON. (A communication from abroad by La Société Anonyme la Force et la Lumière Société Générale d'Electricité, of Paris.) Dated March 14. 6d. Relates to electric or voltaic batteries, and it consists in the employment in the construction of the said batteries of vessels or receivers made narrow at the lower part and wide at the upper part, the said vessels being filled with a suitable liquid and superposed in any desired number and arranged in such a manner that each vessel is immersed to a certain extent in the liquid contained in the vessel next below it, as hereinafter described.

1107. "Electrical bath apparatus." W. R. LAKE. (A communication from abroad by Basile Barda, of Vienna.) Dated March 14. 6d. Relates to an improved electrical bath apparatus suitable for public bathing establishments, or other hydrotherapeutic institutions and for private houses.

1119. "Telegraphy." SYDNEY PITT. (A communication from abroad by Orazio Lugo, of New York.) Dated March 15. 10d. Relates to electric circuits for telephonic or telegraphic transmission, and the improvement consists in a novel organisation of the conductor composing said circuits, whereby interference arising from action and reaction upon each other of derived or induced currents is prevented.

1384. "Electric lighting apparatus." W. R. LAKE. (A communication from abroad by Alfred G. Holcombe, of America.) Dated March 29. 6d. Relates to im-



provements in electric lighting apparatus. Figure 1 is a side elevation partly in section of an electric lighting

apparatus, in which the current is divided to actuate independent feeding and arc-forming devices. The electric current from the generator is divided at *j*, and passes through two independent circuits, 1 and 2. The circuit, 2, includes the two parallel flat coils, f^2 and f^3, and is always closed; and the other circuit, 1, includes the solenoids, *m*, m^1, and the carbons, *a*, a^1, and is closed only when the carbons are in contact, or when the arc is produced between their ends. The whole of the current first passes through the two flat coils, f^2 and f^3, thus instantly releasing the brake wheel, *e*, and allowing the rod, *c*, and carbon, *a*, to fall until arrested by the carbon, a^1; the circuit, including the solenoids, *m*, m^1, and the carbons, *a*, a^1, is thereby closed, and the greater part of the current passes through it, as its resistance is much less than that of the circuit, 2. The solenoid, m^1, is now attracted within the solenoid, *m*, against the action of the spring, *n*, drawing the carbon, a^1, with it from the carbon, *a*, and forms the electric arc between the ends of the carbons. The upper carbon, *a*, is now held up by the brake devices, *e*, e^1, as the spring, *h*, is adjusted to oppose the mutual attraction of the flat coils, f^2, and f^3, due to the amount of the current now passing through them.

2943. "Electro-magnetic motors." SYDNEY PITT. (A communication from abroad by Moses Gerrish Farmer, of America.) Dated July 5. 6d. Relates to certain improvements in electro magnetic motors, in which the ends of an electro-magnetic coil or helix are united just before the connection between the helix and the electrical generator is broken, whereby the spark due to the discharge of the extra or induced current from the coil is prevented.

City Notes.

Old Broad Street, November 3rd, 1881.

THE WEST INDIA AND PANAMA TELEGRAPH COMPANY, LIMITED.—The ninth ordinary general meeting of the members of this company was held to-day at the Cannon-street Hotel. The report of the directors, sets forth the accounts for the six months ending 30th June, 1881. The amount to credit of revenue is £41,303 4s. 1d., which includes £1,535 16s., interest received from underwriters in respect of insurance on the s.s. *Investigator*. The expenses have amounted to £29,366 12s. 8d., leaving £11,936 11s. 5d., which, with the balance of 1,956 5s. 9d. from last half-year's account, makes a total of £13,892 17s. 2d., out of which it is proposed to make a payment of 3s. per share on account of arrears of dividend on the first preference shares, amounting to £5,184 9s., and to carry the balance to current half-year's account. The traffic receipts for the half-year are practically the same as those for the corresponding period, the revenue of both periods having been affected by interruptions. All the stations of the company are now telegraphically connected, and the only cables interrupted are the original Jamaica-Santiago and Jamaica-San Juan sections, which are duplicated. These cables are in course of repair. The directors, from the experience they have gradually obtained, have had in contemplation the deviation of those sections of cable which have frequently failed over the same ground. Most of the necessary soundings to ascertain if safer routes could be selected have been completed by H.M.S. *Fantome*, and the company's s.s. *Duchess of Marlborough*. One of the most important of the deviations proposed, viz., that of the St. Thomas-St.-Kitts cable, was carried out by the company's s.s. *Grappler* in September last, with an expenditure of about 65 knots of cable. The whole of the detailed reports of soundings have not yet been received, but there is reason to hope that safer routes can in some cases be found, and that the effect of the deviations will be to reduce the chances of interruption. Three hundred knots of cable have been ordered, which will be ready for despatch to the West Indies in January next. The 7 per cent. debentures of the company, amounting to £10,200, became due on 1st May last. £4,400 of these were renewed at 6 per cent., the remainder have been retired, and £26,600 debentures have been issued on the terms stated in the circular of 25th June last, making the total issue of debentures to date £35,000 at 6 per cent. per annum. The directors proposed that Mr. Grosvenor should visit the West Indies again this autumn to continue the negotiations for increase of subsidies, and to endeavour to secure unanimity in the decisions of the Governments; but the prevalence of yellow fever in many of the colonies, and the quarantine regulations arising therefrom, interposed obstacles to travelling from island to island and necessitated the postponement of Mr. Grosvenor's visit. The negotiations have, however, been continued by letter, and it is understood that the Secretary of State for the colonies has communicated with the several Governments, recommending a conference of delegates to consider the telegraph question. Application for a subsidy has also been made to the Government of France, and is under the consideration of the Ministry. Mr. C. W. Earle, the chairman, said that, compared with the gloomy period 18 months ago, their position had improved, for they were able to pay their preference shareholders a dividend. There was, he was glad to say, no interruption in communications; but he was sorry to say, on the other hand, that some of the colonies had refused subsidies. With respect to France, it was proposed to lay before the Assembly a proposition to pay the company a subsidy of £4,000 a year. There was no doubt that the colonies were anxious for direct lines to this country. The ships of the company had been well employed, and had only been in harbour for the time necessary for repairs. The first duty was to maintain the lines, and if that was done public feeling in the West Indies would improve in their favour. Since the issue of the report the directors had placed the remaining £50,000 to debentures. He moved the adoption of the report. A discussion followed at the close of which the report was adopted.

BRAZILIAN SUBMARINE TELEGRAPH COMPANY, LIMITED.—The sixteenth half-yearly ordinary meeting of the shareholders in the above company was held October 28th at the City Terminus Hotel, under the presidency of Viscount Monck (the chairman of the company). The report of the directors for the half year showed that the revenue amounted to £86,017, the working expenses to £12,710, leaving a balance of £73,307, to which was added £34,310, the undivided profits to 31st December last, making a total of £107,617. After deducting income tax £1,107, there remained a balance of £106,510. A third interim dividend, amounting to £19,500, had been distributed, leaving the sum of £87,000, for appropriation. The directors now declared a final dividend of 3s. per share, making a total of 6 per cent. for the year, and the payment of a bonus of 2s., which together would amount to £32,500, being a distribution in the aggregate of 7 per cent. for the year, leaving a balance of £54,510,

of which £50,000 had been added to the reserve fund, increasing that fund to £345,349, leaving £4,510 to be carried forward. The chairman, in moving the adoption of the report and statement of accounts, said he would trouble the shareholders with but very few remarks on the present occasion, for the simple reason that he had a very short story to tell. Referring to the table at the bottom of the report showing the receipts every year since the cable commenced operations, he thought the facts there disclosed were, to say the least, not unsatisfactory—(hear, hear). Beginning with the receipts of the year 1874-5 of £128,000, they kept creeping gradually up every year until they amounted to £167,000 in the present year. He did not think that could be otherwise than satisfactory to the shareholders. It showed the sound and gradual increase in the receipts of the cable, and that was combined with a gradual increase in what they had often had some discussion about in that room, viz., the reserve fund, which now stood at the present price of the investments in their ledger. That, of course, included the £50,000 which it was proposed to put in the reserve fund for the past year. There was another subject in connection with the receipts which was also satisfactory, and that was that the gradual increase in the receipts and reserve fund had been accompanied by a gradual contemporaneous increase in the net receipts of the shareholders. Last year they paid a dividend of 6 per cent.; this year they declared 7 per cent. As soon as the board were satisfied that they could give them—not 7 but 20 per cent.—consistently with the maintenance of their concern, they would give them every shilling they earned, but they considered it was absolutely necessary to lay up in order to secure the permanence of their dividend. Turning to the other side of the account, he said the expenditure for the past half-year, as compared with the previous half-year, showed an increase of £967. That increase was exclusively confined to the stations out of London. The general expenses in London showed a decrease of £59. The increase in the out stations was brought about by certain special payments, which must recur after certain periods of time, but which did not recur every year. That was due to the fact that they had spent £454 for new furniture, and they had paid a sum of money to the Brazilian Government for the importation of those articles into the Brazils. There had also been a new Government tax imposed at Pernambuco and Lisbon, which accounted for about £120 more. Turning from the accounts, he paid a brief tribute of respect to the memory of his late colleague, Mr. W. H. Clark. There was one other point, standing there as he did as the representative of their managing body, upon which he ought to touch. He alluded to the fact that a diminution of the insulation had taken place in one of the three sections in which their cable was divided, as follows:—From Lisbon to Madeira, from Madeira to St. Vincent and Cape de Verde, and from St. Vincent to Pernambuco. The cable, however, was working perfectly well; it was carrying all the messages they wanted, but there was undoubtedly this depreciation in the insulation. Experiments had been made, tests had been applied, with the result that the flaw had been localised and calculated to exist somewhere about 30 miles from Pernambuco, in water of not more than 14 or 15 fathoms. The repair of the cable was as certain as if it were lying on the floor of that room, but it was a mere question of time and expense. They had sent out directions to work the cable as long as it would hold, and in the meantime they were doing there business and taking their receipts just as they did before. Having assured them that there was not the least cause for alarm, he concluded by moving the adoption of the report, which was seconded by Sir James Anderson (vice-chairman), and upon being put to the meeting was declared unanimously carried. The dividend was then declared, and Sir Thomas Fairbairn, bart., having been duly elected a director of the company, a shareholder rose and put several questions. The chairman, in reply, having reminded the hon. proprietor that his remarks were out of order, said with regard to the three sections it was quite plain that any one of these sections might give out, but the other two would remain in full working order. He declined to answer the next question, which had reference to the reserve fund. They had the exclusive right of carrying messages to the Brazils for nearly twelve years more. The usual compliment to the chairman, directors and officers of the company brought the meeting to a close.

EDISON GOWER BELL TELEPHONE COMPANY OF EUROPE.—We are informed that a new company (with a capital of £500,000) for working the telephone in most of the principal countries of Europe has been registered under the above title, with Colonel Gouraud as chairman.

INDO-EUROPEAN TELEGRAPH COMPANY.—Direct communication with India by the Indo-European line is at present interrupted from this country owing to the breakage of the submarine cable between England and Germany. The line is, however, working as usual in connection with the Continent of Europe.

The following are the final quotations of stocks and shares for Nov. 3rd.:—Anglo-American, Limited, 52⅝-53; Ditto, Preferred, 81½-82½; Ditto, Deferred, 23⅞-24; Brazilian Submarine, Limited, 11⅛-11⅜; Brush Light, £4 paid, 7¾-8¼; Ditto, £10 paid, 16-17; Electric Light, 1-1¼; Consolidated Telephone Construction, ⅞-1⅛; Cuba, Limited, 9½-10; Cuba, Limited, 10 per cent. Preference, 16-17; Direct Spanish Limited, 5-5½; Direct Spanish, 10 per cent. Preference, 14½-15⅛; Direct United States Cable, Limited, 1877, 10⅞-11; Debentures, 1884, 100-103; Eastern Limited, 10-10¼; Eastern 6 per cent. Preference, 13-13¼; Eastern, 6 per cent. Debentures, repayable October, 1883, 100-103; Eastern 5 per cent. Debentures, repayable August, 1887, 100-103; Eastern, 5 per cent., repayable Aug., 1899, 105-108; Eastern Extension, Australasian and China, Limited, 11-11¼; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 108-111; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 102-105; Ditto, registered, repayable 1900, 102-105; Ditto, 5 per cent. Debenture, 1890, 99-102; Eastern and South African, Limited, 5 per cent. Mortgage Debentures, redeemable 1900, 102-105; Ditto, ditto, to bearer, 102-105; German Union Telegraph and Trust, 10¼-10¾; Globe Telegraph and Trust, Limited, 6⅜-6⅝; Globe, 6 per cent. Preference, 12¼-12¾; Great Northern, 11¾-12¼; 5 per cent. Debentures, 103-106; India Rubber Company, 24-25; Ditto, 6 per cent. Debenture, 104-105; Indo-European, Limited, 27⅞-28⅜; London Platino-Brazilian, Limited, 4⅞-5; Mediterranean Extension, Limited, 2½-3; Mediterranean Extension, 8 per cent. Preference, 9½-10; Oriental Telephone, ¼-⅜; Reuter's Limited, 12-12½; Submarine, 290-300; Submarine Scrip, 2⅜-2⅝; Submarine Cables Trust, 97-100; United Telephone, ——; West Coast of America, Limited, 4¼-4¾; West India and Panama, Limited, 1¾-2; Ditto, 6 per cent. First Preference, 7½-8; Ditto, ditto, Second Preference, 6¼-6¾; Western and Brazilian, Limited, 6¾-7¼; Ditto, 6 per cent. Debentures "A," 110-115; Ditto, ditto, ditto, "B," 98-102; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 123-128; Ditto, 6 per cent. Sterling Bonds, 104-107; Telegraph Construction and Maintenance, Limited, 26½-27½; Ditto, 6 per cent. Bonds, 104-108; Ditto, Second Bonus Trust Certificates, 1⅛-1⅜.

THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

Vol. IX.—No. 212.

THE ELECTRICAL EXHIBITIONS.

Within two days of this date the grand display of electrical inventions now at the Palais de l'Industrie, will, so far as the public are concerned, be terminated. The highest praise is due to all who have taken a share in its promotion and management; to M. Cochery, M. Berger, and M. Breguet, the greatest credit is due, for their enterprise and skill; and of the British Commission also, much might justly be said in praise of the way in which their difficult work has been accomplished, for all the members thereof worked right earnestly and well. Lord Crawford, Professor Hughes, and Mr. Aylmer, have indeed been most indefatigable in their efforts to make the exhibits of their nation in every way worthy of it, and the thanks of the electrical community, we think, will be freely accorded to them for the success so ably obtained. And now, as the electric luminaries of the Paris Exhibition cease to shine, our thoughts begin to be occupied by the on-coming exhibition in the great holiday-making palace on the Sydenham Hills.

After the meeting on the 24th October we wrote that there was every probability of the exhibition being a success, and what we wrote then we fancy will be found correct when everything is ready. December will probably be past before much is placed before the public gaze; but the idea of the directors is, we understand, to let the exhibition gradually expand, and thus leave it open to exhibitors to supplement the exhibits displayed at the commencement. There seems to be but little or no doubt that, from the directors' point of view, so far as the electric light exhibition is concerned, the success must be great. From the electrician's stand-point, however, it may be different. The management make no secret that the shillings are what they cater for, and that they care little for exhibits which are not considered by them attractive to the public. An instance was cited by a very prominent gentleman to show how necessary it was to exclude some of the exhibits which obtrusive (?) inventors were desirous of displaying. We quote as closely as possible from his words; they were as follows:—"Now, we have had an application from some people who want to exhibit gas through which they pass an electric current, and by so doing get more light. It is not electricity, and we cannot therefore admit it; the line must be drawn somewhere!" We could not but feel that this gentleman was not to be congratulated on his discretionary qualifications, for if a given amount of gas and electricity will give more light when combined than when used separately, to demonstrate this fact to the public would for them have an immense attraction, and consequently for the Crystal Palace Exhibition be of great value.

We merely mention this as an indication of the spirit in which the exhibition is being inaugurated. Another sign of this spirit is the omission of what was displayed under Class 16 at the Paris Exhibition, namely, "Bibliographie, Histoire."

Why the directors, having *first* made their programme, should ask the gentlemen who form the honorary council of advice to associate themselves with such an exhibition we cannot see, unless it be merely by way of advertisement. Nor can we perceive the fairness of the appeal to "the City companies and the public generally" to give prizes because "of the public advantages likely to accrue."

The public are not all shareholders!

It cannot be allowed that the Crystal Palace is the best place in or near London for such an exhibition: this, partly because it is essentially a place for pleasure-seekers and not for scientific thinkers, and also because of the £ s. d. way in which it is understood the directors usually regard, and rightly so, their business, and also partly by reason of its distance from the metropolis. Another element likely to prove disadvantageous is that of time; the Exhibition will probably be found to come too soon after that at Paris to attract, as the latter did, electricians from every civilised land. Indeed it seems to us on consideration that the new venture must, to prove the success we wish it, be regarded as a great competitive exhibition of electric lights for the purpose of advertising those lights, and perhaps as a gigantic bazaar and mart at which electrical toys, &c., may find a sale.

We doubt not that thus far the Exhibition will answer the purport of the C. P. directors, but we can only regret that those gentlemen who have nominally been asked to advise the directors had not been invited to do so before the programme had been definitely laid down, so that an electrical display with the widest possible scope and interest might have been held, and not one limited by the main desire to attract so many thousands of the British public at one shilling admission. For it must be borne in mind that by having an exhibition of the kind all too soon and under such conditions, it must militate against the chances of holding one

even more perfect than that of Paris, later on, and, moreover, which might have found, and we hope will find, a temporary home in the more congenial surroundings (from a scientific point of view) of South Kensington. Should this hope be consummated we trust the arrangements will be directed from their commencement by gentlemen interested truly for the advancement of electrical science and in scientific and technical education. Originating with such promoters, the affair will be above the suspicion of other than high class aims, and the promoters cannot well afterwards be placed in the position of effigies intended only to move when the wires are pulled by those who look only for their own special advantage in getting up the show.

As regards the Crystal Palace Exhibition, we think now, as we did when we wrote of the meeting at the Mansion House, that the pecuniary success of the display may be great; but the more we hear of the method of conducting the whole preliminary arrangements, the more are we enlightened as to its non-scientific aim, and as to the nature of the advantages of such an exhibition to the electrical profession.

THE PARIS ELECTRICAL EXHIBITION.

FOREIGN SECTIONS.

ROSSI'S APPARATUS FOR THE CONTINUAL REGISTRATION OF SISMIC EARTH WAVES.

Italy.

THIS apparatus, which is shown by the figure, has four parts—the first of these is called the "*Protosismograph*," and its arrangement is as follows:—A seconds pendulum provided with a very heavy bob is tied by silk cords to four posts corresponding to the N, S, E, and W points of the compass. These cords are of such a length that needles placed at their centre cause them to form an angle of 155°. By this arrangement each horizontal undulation of the pendulum becomes transformed into a vertical movement of the needles of three times the amplitude. Consequently, since the needles are connected above to little metallic spirals of great flexibility, their vertical movements close four electric circuits each time that their points touch the mercury contained in four little cups immediately beneath the points. In this way it is possible to distinguish by means of a registering apparatus each half oscillation of the pendulum, and consequently the direction of the first movement.

The second portion of the apparatus is called the "*Microsismograph*." This has the same mechanical combination as the foregoing instrument, but the silk cords are connected to four pendulums, of different lengths to the centre one. Since these pendulums have different times of oscillation, it follows that at some time or other two pendulums approach one another, and consequently that there is an increase in the number of the needles that make contact. The apparatus is thus able to register pendulous movements of the very smallest degree. Besides, the existence in the apparatus of five pendulums of different lengths gives it the property of responding to sismic waves of different velocities. Experiments made since 1876 have shown that this apparatus is invaluable for sismological purposes, since it can trace out an actual curve of the microsismic and sismic disturbances.

The "*Registering apparatus*" consists of a clockwork movement which causes a paper band to move beneath pencils which are joined to five levers, each movable by the action of a separate electromagnet. Four of these magnets correspond to the four circuits of the protosismograph; the fifth is worked only by the microsismograph. In this last instrument it would be useless to have more than one pencil, for being subject to a variety of extremely slight movements, their direction would be inappreciable.

The "*Sismic microphone*," which forms the fourth part of the apparatus, should be very firmly rooted to the ground, and should have at the same time in its vibrating part a great inertia in order to be insensible to local disturbances. Moreover it should be very steady in its working. With this view it is simply a metallic swing with a screw to regulate its sensibility; the whole is mounted on a stone table like a paper press. The little square metallic support which acts as a spring is for the purpose of supporting an ordinary watch. By this arrangement the only part of the apparatus required for the watch is in a condition of such sensibility as to be capable of showing in the telephone the "tick-tick" of the watch. This "tick-tick" is of great importance in sismic observations.

DE GEYTER'S MULTIPOLAR ELECTRIC MOTOR.

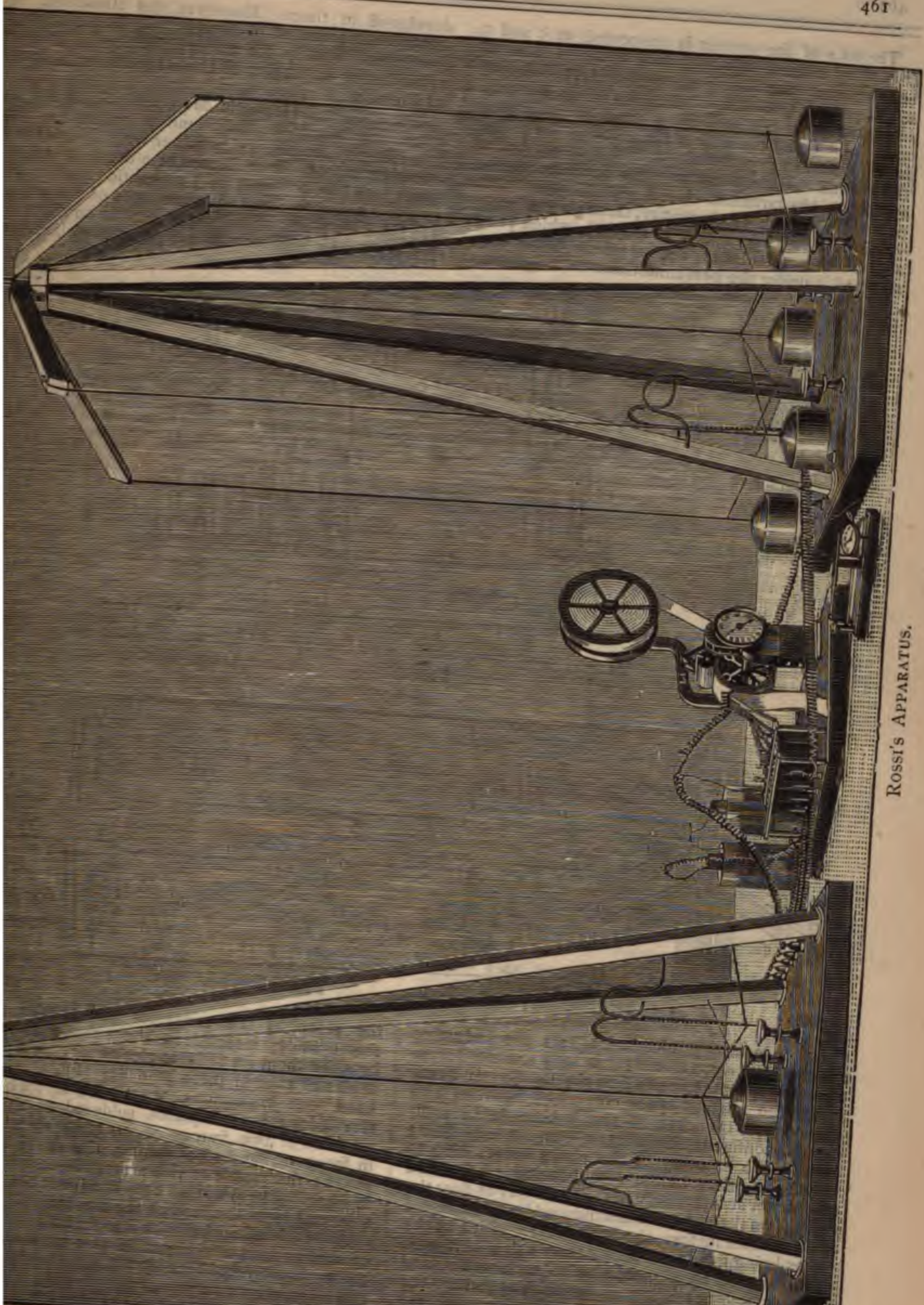
Belgium.

This apparatus is shown in longitudinal elevation by fig. 1 (drawn to the scale of 0.,^{m}50 to 1 metre); it is composed of three parts: 1st, a rotatory apparatus with multipolar electro-magnets (not shown in the figure); 2nd, a fixed multipolar apparatus, A; 3rd, a commutator, T.

The "Electro Magnetic Multipolar Rotatory Apparatus" is formed of an axle, A, A (fig. 2), of soft iron whose end portions are of a smaller diameter than the middle. On this axle are fixed six plates of soft iron, *a*, *b*, *c*, *d*, *e*, *f* (fig. 3), forming between them six equal angles of 60°. These plates are rectangular in form (P, P^1, fig. 2), their greatest length being parallel to the centre axle.

At the lower part, to the right and left, the plates carry projections M, M^1, which are fixed to corresponding projections on two wheels R, S and R^1, S^1, these wheels being fixed on to the axle, A, A.

On these plates and along their longer length are wound a number of turns of insulated copper wire of about 1 millimetre diameter. The wire being parallel to the axis of the apparatus, the inductive action of the current which circulates in the wire magnetises the plates, so that their outer edges become poles of one kind and their inner edges poles of the reverse polarity. The same wire is wound successively on all the plates, but so that the alternate plates only have the same polarity.



ROSSI'S APPARATUS.

The axis of the system is supported at C and C (fig. 1) by frames. At each end of the apparatus and between the supports, C, C, and the wheels, R, S, R', S', are two brass ferrules, V, V' (figs. 1 and 2), insulated from the axis by a ring of insulating material. One extremity of the wires on the plates is connected to one ferrule, and the other end to the second ferrule. During the rotation of the apparatus the circuit is closed with respect to the poles of a source of electricity, through the intervention of two springs, L, L' (fig. 1), which press against the ferrules. The machine thus constructed is under the best conditions for magnetisation. In ordinary electro-magnets the inductive action of the electric current is only exercised from the outside to the inside; in the De Geyter apparatus, the angular space comprised between two consecutive branches of the bobbin being sufficiently confined, the electric current circulating around one or other of the plates serves also to induce an effect in the neighbouring plates, and this action acts precisely in the same way as does the current on the plate which is induced by this external action. Still further, the lower extremities of the plates being firmly connected to an axis of soft iron, and being in close proximity to each other, and these extremities being of opposite polarity, the plates are in a highly favourable condition for *having the* maximum amount of magnetism developed in them. Moreover, the attraction is still more augmented by the peculiar form given to the plates. Finally, the multiplicity of poles allows of the better utilisation of the magnetic actions, to which we shall refer.

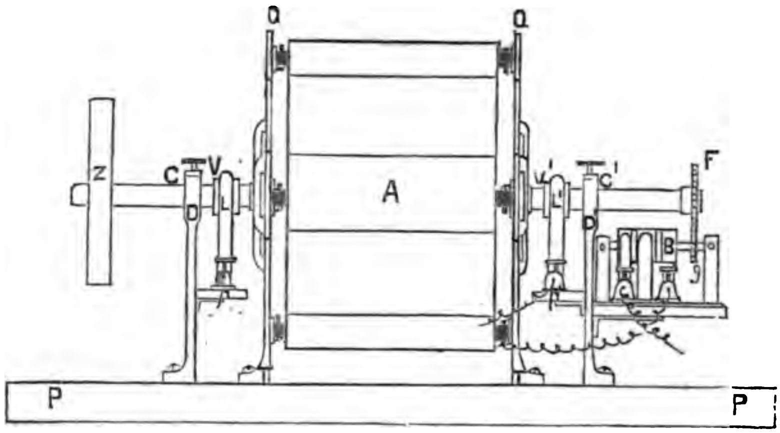


FIG. 1.

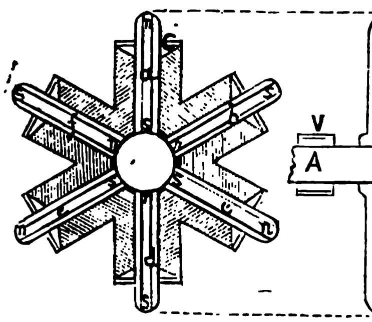


FIG. 3.

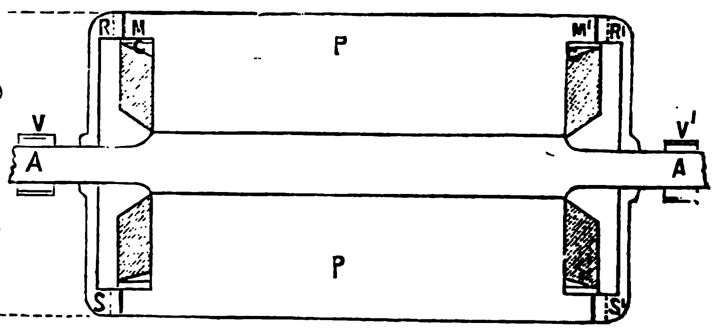


FIG. 2.

The "Electro-Magnetic Multipolar Fixed Apparatus" is based on the same principle as the foregoing apparatus, and together with it forms the complete motor. It is formed of a drum of strong sheet iron (fig. 4), bent to a prismatic shape, with twelve equal sides; on the inside faces of this prism are fixed six plates of soft iron, similar to those of the multipolar bobbins. These plates are placed in the plane of the generator and of the axis of the cylinder inserted in the prism; they form between them six equal angles of 60°. To the four angles of each of these branches (fig. 5), there are fixed four projections, M, M', M'', M''', which are screwed on brass squares, soldered to the inside partition of two frames of the same metal, placed in front of, and also behind, the drum and the plates; the profile of this arrangement is indicated in fig. 4. These frames keep the branches in position, and form the base of the machine.

An insulated copper wire is wound a great number of times round the plates, in the same way as on the multipolar bobbins of the rotatory portion of the machine.

The general management of the apparatus is as

follows :—The motor is formed of a multipolar electro-magnetic bobbin, placed in the axis of a fixed multipolar electro-magnetic apparatus (fig. 4); the frames, Q, T, and Q', T', keep the drum, A, and the electro-magnets together (fig. 1), whilst the supports, D and D', of the ends of the multipolar bobbins are solidly screwed on a strong base, P, P (fig. 1). At one of the extremities of the axis of the rotatory bobbin is fixed a pulley, Z, by means of which power is transmitted from the machine; at the other end of the axis a small toothed wheel, F, is fixed which actuates a commutator.

When an electric current circulates in the two parts of the motor, each of the poles of the rotatory bobbins become placed between two consecutive poles of the fixed apparatus, consequently each will be attracted by one and repelled by the other, for the magnetic polarity of the fixed poles are reversed alternately. Since the two forces are in the same direction, they assist each other, and as the magnetic reactions of all the extremities are also all in the same direction, the movable system is moved round by all the attractions and all the repulsions of

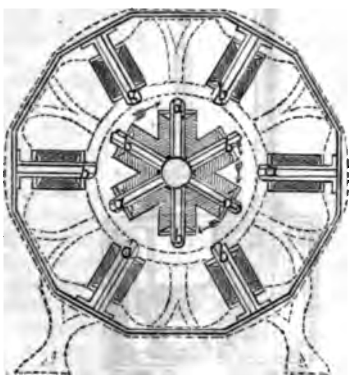


FIG. 4.

the apparatus. The poles of the movable bobbin tend to come to rest opposite the poles of the fixed bobbins, but the inertia of the mass carries them beyond this position, and, moreover, the current circulating in the bobbins is interrupted for an extremely short time at the moment when the movable branches pass before the fixed branches. The current in the multipolar movable magnet circulates always in the same direction, but is reversed in the fixed magnets each time that a movable bobbin passes a fixed one. This reversal of the current is effected by means of the commutator.

The magnetic actions exert themselves at a large number of surrounding points, and consequently the arrangement is very favourable to produce a good effect, especially as the attracting and repelling surfaces are of great length. Moreover, it is well known that the intensity of the magnetic attractions and repulsions is inversely proportional to the square of the distance. Now this distance being always very small in the De Geyter apparatus, in consequence of the multiplicity of the poles, it follows that the actions are exerted always under very favourable conditions. Still more, there is an advantage which is not met with in any other motor, namely that all the electro-magnets act usefully, not merely one at a time, but all together; no portion of the magnetic actions is lost, whilst in all other systems these forces are only utilised to a partial extent in doing work.

In order to make the machine work, it is only necessary to send an electric current through the insulated wire of the two portions of the apparatus, and to stop it the circuit has merely to be broken. The stoppage thus obtained is not instantaneous, but it can be made so by employing a Rhumkorff commutator, or other means of reversing the current in the rotary bobbins without altering that in the fixed ones. The movable extremities then repel the fixed poles as they approach them, and attract as they recede. They thus act in the reverse direction to that in which the machine turns, and consequently must arrest its action. The reverse current thus used should not be allowed to circulate for any length of time, else the motion becomes reversed instead of merely arrested. The machine once set going always runs with a uniform velocity as long as the work done does not alter; this

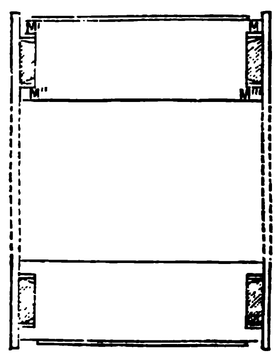


FIG. 5.

velocity can, however, be modified at will by means of a rheostat inserted in the circuit.

It may be remarked that the De Geyter machine can be employed as a current generator, but its principal use is as an electric motor. There are several reasons why the latter use is the more preferable of the two: the rotatory bobbins which are employed possess all the qualities of the Siemens bobbin, and have besides several advantages over the latter; in fact, with the same quantity of electricity the power obtained with the De Geyter bobbin is stated to be much greater than that from the Siemens. The latter cannot give as good results, since its dimensions are necessarily restricted; if it were constructed of a great size, the acting distance of the poles would become too great to give a good effect; if, on the other hand, it were made small, then the time for the magnetisation to become effective would be too short. In the De Geyter machine it is possible to adopt large dimensions, without inconvenience nor loss of power, for the arrangement is not limited to six branches, but can have as many as necessary, in order that the pull between the poles may be at as short a distance a possible.

THE GÜLCHER ELECTRIC LAMP.

The Gülcher electric lamp, which is shown by figs. 1 and 2, is distinguished by its simplicity. Its action depends on an almost forgotten principle of regulation, that of the magnetic pressure-brake; this principle has been applied very successfully. The novel and ingenious arrangement of the lamp is as follows, (fig. 1):—The upper and lower carbon holders and the other is drawn downwards by the iron, H, fixed to the case, thus producing the luminous arc. As the carbons burn away, the magnet, D, is pushed back again by the spring, and finally is brought close to the peg, L, where under normal circumstances it remains quiet during the whole time of combustion. If in consequence of the further consumption of the carbon rods the current is weakened, the magnet, D, lets the rod, F, go, and

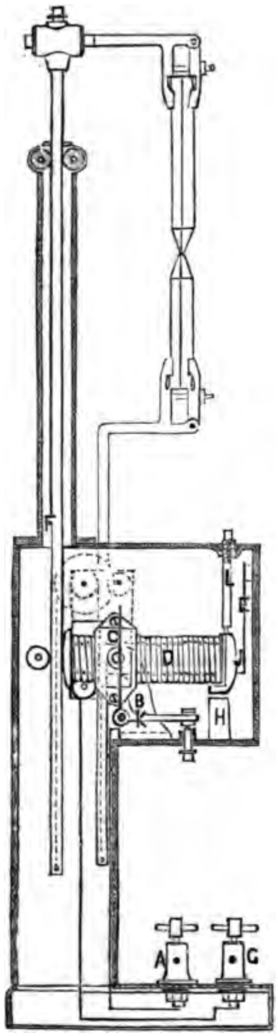


FIG. 1.

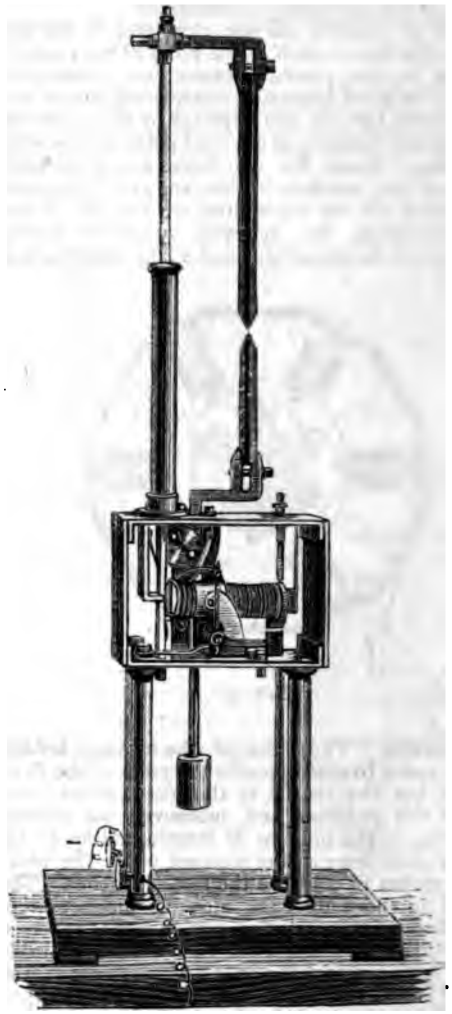


FIG. 2.

are connected together by means of cords. The upper holder, F, made of iron, moves in front of an electro-magnet, D, which revolves on C. The two polar surfaces of the latter are rounded in circles whose centres lie in C. By means of a spring, the tension of which is regulated by the lever, K, the electro-magnet is pressed against the peg, L. When a current passes through the lamp the one pole of the magnet holds the rod, F, fast, the carbons approach each other. In order to prevent the movements of the electro-magnets being too violent on lighting the lamps, or under other abnormal circumstances, the regulating pole of the electro-magnet is provided with a small magnetic brake, J.

The Gülcher lamp acts so well that no fluctuation of the light is perceptible. Fig. 2 shows the new model of the lamp in elevation.

The arrangement of the lamps in the circuit is the most remarkable feature in the whole system. We see here for the first time an automatic regulator which without differential bobbins, &c., can be applied to the production of several lights from a single source of electricity. If we suppose two of the lamps above-described introduced in a parallel position between the poles of a source of electricity it will be plain that the one lamp regulates the other. Let lamp, A, be kindled by closing its circuit, then when the second circuit of the lamp, B, is closed the main current (which is rendered stronger by the double closing) is divided into two branches. The branch which flows through the lamp, B, is stronger than that of A, because in B the carbon points touch each other, and the resistance in this branch is feebler than in the other. As a consequence, the lamp, B, is brought into action by the energetic action of the electromagnet, which withdraws the carbon points from each other, whilst in lamp, A, in consequence of the decrease of this branch of the current the carbon points are approximated, and so the light is rendered stronger. Thus each lamp regulates the other and consequently itself, so that in a very short time they are brought into complete equilibrium.

The advantages of a good parallel circuit arrangement and of the application of currents of great quantity are, that the light produced is of a yellowish or white colour without the violet or blue cast of the light of currents of high tension; the regulators on account of their simplicity can be produced cheaply, and any number of the lamps can be extinguished and rekindled without affecting the rest. The attention required for the lamps when in use, and even contact with uncovered parts of the conduction, is free from danger.

The arrangement for effecting an equal distribution of the current among the lamps is as follows:—As soon as the number, n, of the lamps to be supplied from the machine is known and the total length of the conductor, the diameter, D, of the conductor for the total current is calculated. Then a diameter, d, is calculated according to the formula,

$$\frac{\pi D}{4} = \frac{n \pi d^2}{4} \text{ or } d = D\sqrt{\frac{1}{n}}$$

and a cord is formed of n wires of the diameter, d, the section of which taken together is equal to the section of a single wire of the diameter, D. This cord is connected with the one pole of the source of electricity (*e.g.*, the positive), and led to the first lamp, where one wire branches off, passes through the lamp and is then led on parallel to the remaining $n-1$ wires; at the second lamp a second wire branches off from the cord and after it has passed through the lamp is united with the wire coming from the first lamp. Going on in this manner the whole of the wires are at last united together again in a cord of n wires which returns to the negative pole of the source of electricity. In this manner the resistance for each lamp is of the same value.

The "Gülcher dynamo machine" is almost identical in principle with the "Schuckert" (see TELEGRAPHIC JOURNAL, April 1st, 1879), and the differences which exist between the two are hardly, we think, in favour of the former.

THE BRITISH SECTION.

THE INDIA-RUBBER, GUTTA-PERCHA, AND TELEGRAPH WORKS COMPANY.

We are compelled to leave, until our next issue, through an accident to the manuscript, the continuation of the notice of this company's exhibit.

ON THE PRACTICAL MEASUREMENTS OF ELECTRICAL MAGNITUDES.

By W. H. PREECE, F.R.S., Electrician to the General Post Office, London.

1. ALL our ideas of magnitude of any kind are simply conceptions of the comparison of some well-known magnitude with that whose dimensions we wish to estimate. Painters invariably put living figures into their pictures, to enable the spectator to form some conception of distance, by comparing the well-known human forms with trees, valleys, or hills. The human form thus becomes a rough standard of reference. But the engineer and the physicist must be exact; their standards of reference must be something fixed and determined. Questions of *distance* are determined by reference to the "metre" or "foot;" questions of *mass* to the "gramme" or "pound;" questions of *time* to the "hour" or "second." Every accurate system of measurement means the direct comparison of the magnitude to be measured with another *of the same kind* and of given determined dimensions, which becomes, for that kind of magnitude, the *standard of reference*, and to which a distinguishing name is given.

2. The relative magnitude of the quantity to be measured and its standard of reference is the ratio of the undetermined to the determined magnitude, and this, in fact, is its *numerical value*, for it indicates the number of times the first magnitude contains the second. Hence the standard of reference is the "unit," for in any numerical comparison it is indicated by 1, or unity, while the other quantity is indicated by the number of times this named unit is contained in it.

If we have two distances, the one of which we will indicate by D and the other by d, their relative magnitude is expressed by the ratio $\frac{D}{d}$ and if we make d one metre then the ratio becomes $\frac{D}{1}$ or simply D, D being the numerical value or the number of metres contained by the distance to be measured.

3. It is customary to express physical quantities of all kinds by letters of the alphabet, but it is important to bear in mind that letters can only be used where the quantity represented can be arithmetically represented by a number. Letters, in fact, simply represent numerical values. When we say "let the time be T," we use T in place of some undetermined arithmetical number of units—seconds or minutes, or hours, as the case may be; or, when we say, "let the mass be M," we mean M grammes, or pounds, or tons, as the case may be, M being any number whatever. We cannot measure one physical quantity by the units of another physical quantity; we cannot measure distance by seconds, or mass by metres. Hence when we express any physical law by an algebraical equation, such, for instance, as Ohm's celebrated law—

$$C = \frac{E}{R}$$

where C represents the current of electricity flowing, E the electromotive force or the power producing it, and R the resistance or obstruction to its flow.

We can make no use whatever of such an equation, unless we can give numerical values to these letters which have reference to the same system of units. If E be measured in terms of the cells of a given battery, and R in terms of some given length of wire, the result is valueless as an exact arithmetical expression of the value of C. Without a definite and determined system of units, algebraical formulæ like the above are mere shorthand expressions of physical laws and facts; with such a system they can become capable of comparison and measurement. Without a proper system of units the formula—

$$C = \frac{E}{R}$$

simply expresses the broad fact determined by Ohm, that a current of electricity varies directly, as the electromotive force producing it and inversely as the resistance opposing its flow. With a proper system of units we can *express and measure exactly* the currents flowing when we change either the electromotive force or the resistance.

4. There must be as many different units as there are different kinds of magnitudes to be measured, but there are only three arbitrary units which by mutual consent have to be accepted as fixed or determined, and these are usually *the mean solar second*, the *metre* and the *gramme*, each of which admits of direct comparison, precise measurement, simple reproduction, and easy verification.

It happens that physical and dynamical quantities, such as those that enter into electrical questions, can be expressed in terms of either or all of these units of time, space, and mass. Hence these units are called *fundamental*.

Any system of measurement based directly on fundamental units is said to be "*absolute*," a most unfortunate name which means nothing, and which alone has tended to deter many from endeavouring to comprehend a system that is not only necessary, but is really simple.* *Invariable* would have been a much better title than absolute, for the second, metre, gramme once having been determined upon are fixed and invariable. *Dynamic* would have been better still, but *absolute* is however an accepted term, and the system of units derived directly from these fundamental units of length, mass, and time is said to be the *metrical absolute system*. An absolute system is not confined to the metre, gramme, and second. The fundamental units may be the *foot, pound*, and *second*. Such a system is called the British absolute system. Indeed, the units of length, mass, and time may be anything we please, but they must remain invariable for that system.

5. Force was defined by Newton as that which produces or tends to produce motion. In gravity, electricity, and magnetism, it takes the form of attraction or a repulsion. Thus bodies fall towards the earth, through the mutual attraction of the earth and the body. Bodies *oppositely* electrified approach each other through their mutual attraction, and *similar* magnetic poles repel each other through their mutual repulsion. Now the magnitude of these forces of gravity, electricity and magnetism can be measured by the rate at which bodies effected by them would move if free, or, in other words, by the space they would pass over in a given time. Thus gravity is found to exert a force in a body in the neighbourhood of Paris free to fall which at the end of one second would generate a velocity of 9·81 metres per second. Forces are therefore measured by the velocities they impart to bodies on which they are impressed. A velocity is length passed over in a given time. One metre passed over by one gramme in one second would be the result of unit force. Hence unit force is defined as that force which if applied upon a gramme for one second generates a velocity of one metre per second. In this sense gravity is a force which equals 9·81 times "absolute" force, for it generates at the end of one second a velocity of 9·81 metres per second. If the motion of a gramme mass under such a force be resisted, we have a pressure analogous to *weight*, weight is the measure of the force of gravity upon matter. Thus the weight of unit mass is 9·81 metrical absolute units of weight.

If the resistance of a force be overcome, if, for instance, a kilogramme be raised perpendicularly one metre high against the attraction of gravity, or if two similar magnetic poles be pressed towards each other against their mutual force of repulsion, something has been accomplished—in other words, work has been done. The power of doing work is termed *energy*, and the amount of energy expended is measured by the distance through which a force acts. Thus unit of work or of energy is defined as that done by unit force acting through unit space. One kilogramme raised one metre is called a *kilogramme-metre*, and it is equivalent to 9·81 metrical absolute units of work. The common unit in England is called a *foot-pound*, which is $\frac{1}{7 \cdot 23}$ of a kilogrammetre.

Energy expended in any other form than that of useful work usually takes the form of heat. Thus the presence of heat is not only an indication of the expenditure of energy, but it is another measure of the amount expended.

This metrical absolute system has, however, certain inconveniences of a practical nature attached to it which have forced physicists and engineers to modify and simplify it for ordinary use. The metre has been found too large, and the centimetre has been adopted instead, as the unit length. Hence we have a system modified from the metrical absolute system which for brevity is called *the c. g. s. absolute system*; c. g. s. being the initials of centimetre, gramme, and second.

In this c. g. s. absolute system the unit of force is called *the* "*dyne*," and the unit of work and energy, *the* "*erg*." The chief reason that led to the acceptance of the centimetre is the simplification it introduces in indicating the numerical value of the densities of different materials. In this system the specific gravity of water and its density are the same, while in the metrical absolute system, the one is one million times the other.

6. Several other absolute systems have been suggested. The Committee of the British Association, in their original scheme, adopted as unit length one earth quadrant (10,000,000 metres), as unit time:—one second;—as unit mass:—the thousand-millionth part of a milligramme. Weber adopted the millimetre as unit length, and the milligramme as the unit mass. But the c. g. s. system has now been very generally adopted, and it is hoped that it will become international and therefore universal. It expresses in definite and uniform measure all the dynamical relations of the physical forces. It is a scientific and natural system, embracing the conception of work. Hence it should be called the *dynamical system of units*. The numerical values obtained are the same in whatever country the observations are made, and they are independent of the apparatus used. It has thus bound together in one homogeneous whole all the sciences, and the units

* The term absolute was introduced by Gauss in his celebrated Memoir of 1832; "Intensitus vis magnetriæ terrestris in mensuram absolutam revocatis," to indicate that this system of measurement was *independent of any kind of instrument and of gravity*.

of force and energy are the golden bands that have effected this desirable union.

The immense advantage which such a system offers, besides its independence of instrument, is the abolition of numerous co-efficients, and the laborious calculations that they entail, which are required to express magnitudes in the language and system of one country, and to translate them to that of another. The almost universal acceptance of the French decimal system has not only paved the way for this desideratum but has rendered it practical and possible. The confusion that arises in comprehending the various national systems for representing lineal dimensions, scales of temperature and weights have only to be experienced to be condemned.

7. Fortunately in electricity there was no system to be superseded, for none existed. It only needed a proper absolute system to be proposed for it to be adopted; but even now a practical system remains for consideration, for the c. g. s. absolute system is not universal, nor is the nomenclature general even in England.

8. An absolute system of units, pure and simple, though theoretically perfect, is, unfortunately, not practical without modification. A system has to be derived from the absolute system to make it practical. With any system there must be excessively large and excessively small numbers, and the selection of any particular derived system is in reality the choice of evils. For instance, the absolute unit of electrical resistance is so small that it is far below the reach of our apparatus, and to make it practical, or to bring it within the sphere of our instruments, we have to multiply it one thousand million times. Again, one English foot-pound is 13,560,000 times the c. g. s. unit of work.

Hence, large numbers have to be used; but the inconvenience of using such numbers is very much diminished by writing large numbers with two factors, one of which is a power of 10. The index 10 represents the power of 10, or the number of cyphers that follow the first figure, 10^5 means 1 followed by 5 cyphers. Thus, the above relation of the unit of work would be indicated by $13{\cdot}56 \times 10^6$ c. g. s. units. The practical unit of electrical resistance, or the *ohm* as it is called, is 1,000,000,000, or 10^9 c. g. s. absolute units of resistance, while the practical unit of capacity is $\frac{1}{1,000,000,000}$ or 10^{-9} c. g. s. absolute units of capacity. The difference between the metre and centimetre is only the difference between the index of the power of 10, and all the principal units of electrical measurement which involve powers of 10. Thus $9{\cdot}81 \times 10^2$ is the acceleration of gravity in centimetres; it would be $9{\cdot}81 \times 10^3$ in millimetres. The quadrant of the earth is 10^7 metres, and the metre is 10^7 of the quadrant of the earth. One "horse-power" is 7,460,000 ergs per second, and is written $7{\cdot}46 \times 10^9$ ergs, while the "force de cheval" is $7{\cdot}36 \times 10^9$, or 7,360,000,000 ergs per second.

9. Every absolute system based on fundamental units of length, time, and mass is easily convertible from one to the other, when we know the ratio that determines the change from one unit to the other of the same kind. The equations expressing these ratios are termed *dimensional equations*. The theory of dimensions or the laws according to which derived units vary when the fundamental units are changed, was developed by Fourier in his *Théorie de chaleur* (§ 160). Their discussion here is not necessary to our purpose. Their introduction in fact very much complicates the explanation of the meaning of any system of units..

(*To be continued.*)

Proceedings of Societies.

THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.

AN ordinary general meeting of this Society was held on the 10th inst., Professor G. CAREY FOSTER, F.R.S., president, in the chair. The minutes of the last general meeting, held in London on the 26th May, and of the extraordinary meetings held in Paris on the 22nd and 24th September, having been read and confirmed, a paper was read by Mr. JOHN LUND (of the firm of Barraud and Lund, Cornhill), on "Synchronising Clocks by Electricity."

The author commenced by saying that the subject he was about to bring forward was unlike any that had yet been introduced before the Society; he was not about to lay down any new law, or to explain an entirely new invention, but simply to show a development of a principle which was old, and which he had for four years worked in order to render a practical success. The records of the Patent Office show that the general problem of the synchronising of clocks by electricity had been worked at for a lengthened period, and indeed at a certain time occupied a very great amount of attention. He divided the methods which had been employed in attempting a solution of the general problem into six heads:—1st. Clocks whose motion was produced by the electric current and which had no pendulums; an example of this was seen in the Shepherd clock which had been empolyed for some time at the Royal Observatory, Greenwich. 2nd. Clocks with pendulums driven by the electric current, Ritchie's, for instance. 3rd. Clocks with spring or weight power, in which the pendulum was controlled by the current. 4th. Clocks of the ordinary type which were given a gaining rate and whose minute or second hand was arrested when it arrived at the mark indicating the hour and was released exactly at the hour by the electric current. 5th. Clocks of the ordinary type whose hands were set at the hour by means of a V piece acting on a pin fixed to the hand, or *vice versâ*, the V piece, or pin, as the case may be, being actuated by the electric current. 6th. Clocks of the ordinary type set to Greenwich time by special contrivances. To Bain undoubtedly belongs the idea of thus setting clocks to time, although he did not succeed in getting the mode adopted.

Roughly speaking, synchronising methods may be divided into three heads, viz., 1st, clocks driven; 2nd, clocks controlled; 3rd, clocks set, by electricity.

Although, in a certain sense, all attempts up to within the last few years to solve the problem may be called failures, yet, strictly speaking, they were not so, inasmuch as a great deal of work was accomplished which was quite necessary before entire success could be achieved. Wheatstone's method was tried for some time, but failed eventually, and he did not believe that more than five or six clocks were ever included in the circuit. The failures, he considered, were due to the fact that the clocks were made subservient to a system, when the reverse should have been the case. What then was the proper system? In the first place, the clock must be entirely independent of any synchronising system which might be applied to it; secondly, the system should be easily adaptable to any existing form of clock; thirdly, the system should correct the clock, whether it had gained or lost. To synchronise the clock by giving it a gaining rate, he considered quite absurd; for practically, the clock could never be correct, except exactly at the hour; whereas, by adopting

the method of correcting for either rate, the clock could be adjusted so as to give as nearly as possible correct time, it being a matter of no consequence whether the adjustment was a little out either way.

With regard to synchronising generally, a distinction must be drawn between the *mode* of synchronising and the *system*. Till lately no person has got beyond the *mode*, whereas to make the idea a practical success a *system* must be arranged. The author contended that his own system fulfilled all the criteria necessary for complete success. It was extremely simple, it could be applied to any clock without difficulty, and was quite independent of the general mechanism of the timepiece. The whole synchronising mechanism was self-contained.

As regards the mode of fixing the mechanism, the question arose, should it be fixed to the wood case or the metal frame? The proper way was, undoubtedly, to fix it to the frame or dial plate. There arose then the difficulty of getting the synchronising pins, which were employed in his system, to clear the glass; to avoid this, the pins were set away from the extreme edge of the dial, and more towards the centre; as the hand could not, under these conditions, clear the pins if the synchronising was done in the ordinary manner, the pins were made short and a small block set behind the hand, against which the pins acted. A great deal of difficulty was found from the fact of the synchronised hand being loose on its axle; this required special attention, as, for accuracy, the hand should be absolutely tight. To attain this, the minute hand spring required to be made springy instead of stubborn, as was usually the case.

As regards the whole system generally, it was very necessary that it be complete, that is to say, the wires should be properly arranged. Gravity escapements were not necessary, the ordinary Graham dead-beat answering every purpose.

The time being given by a standard clock, it was found at first that the latter might fail from being accidentally allowed to run down. This difficulty was overcome by employing two clocks which were wound on different days. As a breakdown of one or other of the clocks required to be corrected, two indicators are employed which, on a failure taking place, at once indicate which clock was in fault. A third clock shifts the circuit from one clock to the other periodically, so that whichever happens to fail the other will be certain to give the signal.

To enable it to be known whether the standard clock was right, an arrangement was adopted by which a small mark was made of a dial by the action of the Greenwich current; this marked showed the position of the hand of the standard clock.

The correction of the standard clock from time to time was a matter of some difficulty. An arrangement had been tried by which small weights were dropped or taken off the pendulum so as to decrease or increase its rate of swing; this device was, however, only partially successful. Sir George Airey had accomplished the requirement by making a coil on the pendulum pass over a permanent magnet; by closing the circuit of the coil the action of the magnet was to check the rate of swing.

To point out how successful his system was, he would say that 3½ millions of signals were sent out on 12 circuits every year, and with great regularity. His system extended to every part of London.

For the purpose of distributing the time signals, he used a simple form of chronofer, with twelve contact springs. He found there was no difficulty in making *good contact* with these springs, although he had been *told that this difficulty* would be experienced. It was discovered that it was not necessary to clean the contacts, as they practically cleaned themselves; and as to the burning away of the contacts, he found the best plan was to go on working till they were completely burned through, and then to renew them.

Very little difficulty was experienced from lightning, as his experience showed that a wire with one end disconnected was rarely damaged.

Mr. LUND then proceeded to describe his testing system, which was of a very ingenious character, the state of the line (as regards an actual break) being reported by a clock, which put a current on each line successively through an indicator, the latter moving over to "line right" if there was good continuity, but remaining at "line broken down" if the current could not pass, owing to a break.

In cases where a visible signal was required to note the exact hour, he employed a red disc, which turned round and displayed its face for 15 seconds at the exact hour.

The use of small time-balls, he thought, had not found favour because they were either expensive or required to be pulled up each time they were required to be dropped. He showed a specimen of this form of time-signaller, in which the ball was wound up by a clock-work train, which became stopped when the ball was fully raised and set. This apparatus would work for three months without requiring to be rewound.

With reference to successes which he had had, he might mention that the Dumbarton time signal, which had been in use for three years, had never failed. London, he said, had now the largest system of electric time distribution in the world.

In the discussion that followed the reading of the paper,

Sir CHARLES BRIGHT described the system of R. L. Jones invented in 1855. In this system the pendulum was synchronised at each beat; this system he considered the best of those which were *continuously* synchronised. The arrangement was tried some years ago in Liverpool, and was very successful.

Mr. STROH asked whether, in addition to setting the hands, some arrangement had not been tried for altering the length of the pendulum at the time the synchronising took place, so that by continual correction, the clock would eventually neither gain nor lose.

Mr. COFFIN said that some years ago at the Stevens' Institute in America he had attempted to solve the problem referred to by Mr. Stroh, but the experiments were only partially completed; in the arrangements he had worked at he had endeavoured to make the amount of correction for the pendulum, to be proportional to the amount of error from the correct going rate.

Mr. CRISBECK said that at the Royal Observatory, Greenwich, the difficulty about contact springs sticking together was got over by using a shunt between the two contacts.

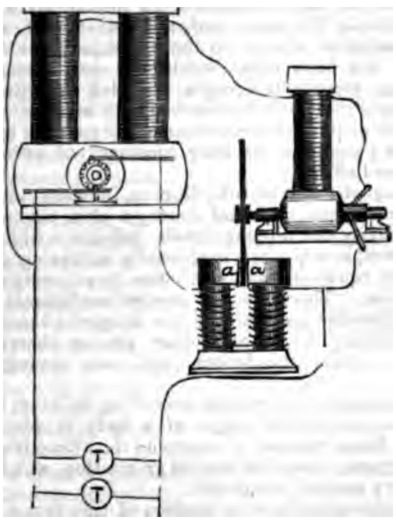
After a reply by Mr. Lund, the meeting adjourned till the 24th, when a paper will be read by Sir CHARLES BRIGHT and PROFESSOR HUGHES on "The Paris Exhibition."

THE COMPAGNIE GÉNÉRALE D'ELECTRICITÉ OF PARIS.—This Company now owns the French patents for the Jamin, Jablochkoff, Jaspar, Werdermann, and Maxim lights; and also for the Gramme Machines.

THE CROMPTON AND SWAN ELECTRIC LIGHTS.—A portion of the London Mansion House is to be lighted by Messrs. Crompton & Co. with the Crompton arc and the Swan incandescent lamps.

Notes.

A CURRENT REGULATOR.—A patent (No. 248, 421, dated March 5th, 1881), has been taken out in the United States, by Mr. Edison, for a "current regulator for dynamo-electric machines. This arrangement, which is shown by the figure, consists in the combination



of a generator, an electro-motor in the field-magnet circuit, carrying a disc upon its rotating shaft, and a magnet in the supply-circuit in whose field the disc rotates, whereby the rate of the motor and the strength of the field-circuit are varied and controlled.

ON THE INFLUENCE OF THE TENSION AND THE VIBRATIONS OF A WIRE UPON ITS ELECTRIC CONDUCTIVITY.—By L. De Marchi.—The experiments were conducted with a differential mirror-galvanometer in both the parallel conductions of which were introduced two parallel wires suspended vertically, one of which was stretched or set in vibration. In experiments with wires of steel, copper, iron, and brass, it appeared that every stretching increased the resistance, only in very feeble stretchings a decrease was sometimes observed. The increase of resistance is in general proportional to the increase of the tension, though the former bears no simple proportion to the elongation. Every vibration affects the resistance, increasing it in general when a sound is produced, but otherwise decreasing it.—*Wiedemann's Beiblätter.*

INCANDESCENCE *versus* ARC ELECTRIC LAMPS.—We hear from various sources that the Incandescence lamps have been so far improved that they can be made to give a light exceeding 600 candle-power without breaking the filament; this being the case, and in view of the further improvements which are certain to take place, it seems highly probable that the days of the Arc lamps, for general lighting purposes, are numbered. It is a fact that many of our most eminent electricians, who are acknowledged authorities on the Electric light question, and who in the first instance strongly argued in favour of the Arc system, have now as strongly declared against it in favour of the Incandescence principle.

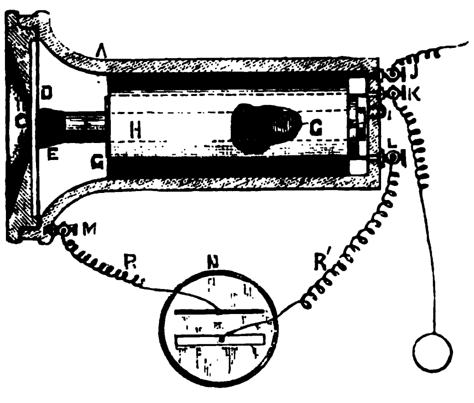
ON AN APPARATUS FOR REGISTERING THE INDICATIONS OF A MIRROR-GALVANOMETER.—By B. P. Samuel.—Two pieces of selenium are fixed to the right and the left upon the screen upon which falls the light reflected from the mirror of the galvanometer. Both pieces of selenium are introduced along with electro-magnets, in two circuits, connected with the same system. The keepers of the magnets are so regulated by springs that they are attracted only when the selenium is illuminated. Platinum points on one of the keepers and platinum triangles on the other are pressed by the attraction upon iodide of potassium paper which passes over a small copper cylinder. The latter, as well as the platinum points and triangles, are so connected with the poles of batteries that a dot or streak appears upon the iodised paper when the points and triangles are pressed upon it.—*Wiedemann's Beiblätter.*

MAGNETS.—With a view to ascertaining the best steel for the manufacture of magnets, determining the most effective degree of hardening to be given to it, and choosing the most simple and practical method of rendering it magnetic, M. Trouvé has made a series of experiments. He has cut bars of steel lengthwise, magnetised them, measured their power, and then has hardened them and again magnetised them. After again measuring their power, he has found that it was increased, so that a magnet, after the second magnetising, will bear a weight which is expressed by the square of the weight it was first able to carry, so that if it had a power of 2, 3, or 4, after the first operation, its capacity would be increased to 4, 9, or 16 respectively after the second. Hardening must be very regular, and manufacturers of steel for this purpose should do the heating in a muffle heated by gas. In order to magnetise, M. Trouvé places the steel bars into two solenoids in juxtaposition, closing the magnetic circuit by means of two plates of soft iron. For generating the current, he employs a battery of six Wollaston cells. In this way M. Trouvé has obtained magnets having a uniform power, his rod magnets carrying as high as 12 and even 14 times their own weight, while with horseshoe magnets it will rise to 48 or 56 times the weight.—*Engineer.*

THE ELECTRIC LIGHT AT CHESTERFIELD.—The trials of the Brush electric light at Chesterfield have been so successful that the corporation have decided to dispense with gas entirely, as far as public lighting is concerned, and to replace it with the electric light. The contract has been secured by Messrs. Hammond & Co., of 110, Cannon Street, London, the general agents of the Brush Company. The lighting will be done by means of about twenty-two Brush arc lamps, and about seventy Lane-Fox incandescent lamps. The annual cost of same is guaranteed by the contractors not to exceed the present gas bill, and it is claimed that the light will be three times as efficient. Deputations have visited Chesterfield from Derby, Nottingham, Barnsley, Sheffield, and other towns, who are now in negociation with the contractors for a trial of the Brush light.

A NEW TELEPHONE.—Mr. J. Milton Stearns has taken out a patent (No. 248,116), in the United States, for the form of telephone shown by the figure. The

arrangement consists of an induction-coil (the primary wire, G, of which is electrically connected to the core, F, and the secondary wire with the line, O, and earth),



a core, F, cushion E, diaphragm D, wire, R, R, and battery, N, as shown.

THE EDISON ELECTRIC LIGHT.—An offer has been made to the Corporation of the City of London, and has been referred to a committee, to light the Holborn Viaduct for two months with Edison incandescent lamps free of charge. The intention is that the houses within a convenient distance shall be supplied with electricity by meter for domestic use.

ELECTRICITY AT THE GREAT EXHIBITION OF 1851.—As a contrast to the immense display at the Paris Exhibition, it is interesting to note the state of electric science as exemplified, three decades ago, at the Great Exhibition of 1851. The following extracts are taken from a synopsis of the official catalogue of the latter exhibition, and are the entire references to the exhibits of the electrical class:—

"Engraving by electricity is a new art, of which examples are shown. The process is to connect the steel plate with one pile of a galvanic battery, and the engraver, a mere metal point, with the other; this is held by means of a glass or ivory handle. Every time the two are brought into contact there is a spark, a small portion of the steel undergoing combustion; therefore the engraving is a series of dots produced by the combustion of the steel effected thus by the agency of the voltaic current. This process is more applicable to steel than to any other material.

"We then have the arrangements for the electric light exhibited, showing how the charcoal poles, or points, between which the light is developed, are maintained at a uniform distance from each other, during the operation of the electric current. The attempts made, hitherto unsuccessfully, to apply electro-magnetic force as a motive power, also receive illustration. The great difficulties are, the loss of power through space, and the setting up of a counter current, acting as an opposing force the moment motion is produced.

"Electrotypes and electrotype apparatus will be found of considerable interest, most particularly some very delicate specimens of flowers, &c., covered with copper, by the process. A film of silver is first formed on the article, whatever it may be, by dipping it in a solution of phosphorus in sulphuret of carbon, and then into a silver solution; after which, it is connected with the voltaic battery.

"Compasses of various kinds, with many of the most approved and the newest arrangements, for preserving these instruments as free as possible from vibration at sea, are exhibited. Near these some electrical machines will be found; also a very powerful steel magnet, constructed on the principle recommended by Dr. Scoresby, and some cast-iron magnets, of much power, which can be readily made at small cost.

"Of electric telegraphs, and machinery connected with them, there are between twenty and thirty exhibitors. We have here the ordinary double-needle telegraph, and all the numerous modifications of that instrument which have been introduced. Many of the contrivances are most ingenious, and all more or less tend towards the improvement of an instrument which is undoubtedly the most perfect illustration of a grand application of science to the useful purposes of man which has been made within our own time. The printing electric telegraphs are also exhibited, and their operations will be observed with much interest, as will also all the improvements made in galvanic batteries for the purpose of insuring constancy of action, and increased effect.

"Magnetic instruments, dipping, intensity, and variation needles will be found worthy a close examination, particularly the dipping-needle deflectors, which have been employed most successfully in tracing out the lines of equal magnetic variation over every part of the globe. There are also smaller instruments of the same class for ascertaining the magnetic character of the primary rocks, and other similar observations. Miners' dials, theodolites, &c., are amongst this group.

"A magnetic balance, of exceeding delicacy, is exhibited, in which the weight of a body is determined by the force required to overcome the attractive power of magnets, instead of that of gravitation, which is the ordinary method employed.

"In the miscellaneous matters of this group will be found many arrangements connected with the applications of gutta-percha as an electrical insulator, and its use in the form of tubing for communicating from one apartment of a building to another with facility, and many mechanical and electrical contrivances of exceeding ingenuity.

"The Electric Clock marks the centre of the transept. The clock is worked by the magnetic power imparted to bars of steel by the electric current generated by the chemical action in a Smee's battery. It will be observed that the pendulum beats in unison with the attraction and repulsion of steel bars opposite the ends of the magnet; when connection is established, the reduced magnetism frees the pendulum from the action of a spring, and thus a uniform rate of oscillation is obtained. This is communicated to the hands by simple machinery, and may be conveyed to any number of dials by very simple adjustment."

NEW CABLES.—The *International* left the Thames on the 9th inst. for Mexico. She has on board the first section of the Central and South American Telegraph Company's cables. The section is composed of an intermediate type of cable, and will be used to connect Vera Cruz with Goatzacoaleos. This, in conjunction with the Vera Cruz, Tampico, and Tampico-Brownsville Cables of the Mexican Telegraph Company, will put the States in direct telegraph communication with the Atlantic side of the Isthmus of Tehuantepec. A land line of some 200 miles will carry the messages to the Pacific side at Salina Cruz, and then the cables continue as follows:—Salina Cruz to San José de Guatemala, San José to Salinas Bay, Silinas Bay to Panama, Panama to Buenaventura, Buenaventura to Santa Elena, Santa Elena to Payta, and Payta to Chorillos for Lima Peru. At Chorillos the Central

nd South American Company's system will join the West Coast of America Telegraph Company's lines to Valparaiso. The completion of these lines will, with the existing lines on the east coast of South America, practically duplicate the telegraph communication between the United States and England and the capitals of Brazil, Uraguay, Buenos Ayres, Chili, Peru, and Ecuador. Should the Tampico-Vera Cruz section be interrupted, telegraph communication with the United States could be made *via* Valparaiso and the Brazilian Submarine Company's lines, and then on through the Anglo Company's lines. If the Lisbon-Madeira section of the Brazilian Submarine Company's line fail, Madeira could communicate telegraphically with Europe by sending *via* Pernambuco, Buenos Ayres. Valparaiso, and north through the new lines to the States, whence communication with Europe is excellent, In fact the new lines will make a perfect duplication of the existing lines by filling up a gap in the circle.

ACTION AGAINST A CABLE COMPANY.—In the High Court of Justice, Chancery Division, before Sir C. Hall, the case of Harold *v.* The India-rubber and Gutta-percha Company was mentioned. This was an *ex parte* application for an interim injunction to restrain the defendant company from laying or shipping for transmission abroad a certain submarine cable. The plaintiff in 1879 and 1880 obtained a concession from the Governments of Columbia, Peru, and Ecuador to lay a cable which was to extend from Guaguile to Lima. It was intended that the telegraph lines should join at Callao, in Peru, with the coast telegraph in Valparaiso and the Argentine Republic. The concession was for 25 years. It, however, had recently come to the knowledge of the plaintiff that the defendant company were about to ship a submarine cable, to be laid in the route which had been conceded to him and his associates exclusively. If the defendants' cable were laid it would entail a serious loss and injury to him. Mr. Graham Hastings, Q.C., appeared for the plaintiff. The Vice-Chancellor said he could not grant an injunction restraining the company from making or shipping this submarine cable, but he would grant an injunction restraining the company from laying or working the said cable. The plaintiff, however, would have to give the usual undertaking as to damages.

Correspondence.

ELECTRIC LIGHT.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—Your correspondent "Electron" seems to have misunderstood my letter of the 1st ult., the point of argument being as to whether the 20 horse-power engine was able to light only 40 incandescent lamps. I did not intend to convey the idea that more light was got per horse-power by the incandescent than by the arc light. Indeed those who have studied the subject at all, know that the incandescent light comes far behind the arc when the total amount of light obtained per horse-power is taken into consideration. Since writing my former letter, the incandescent lamp has been introduced into some of our large Manchester firms, where it has been put up, not so much with the object of competing with gas, as that coloured goods may be identified and matched as readily as in daylight. In every instance it is well spoken of. Surely this is a proof of its illuminating power. I can assure "Electron" that the firms I allude to have carefully considered the whole matter. One of them indeed sent a gentleman over to the Paris Exhibition to thoroughly test the utility of the incandescent light for their purpose. Manchester people are not given to spending money on any useless novelty that may be introduced.

Many besides myself would be glad to know where a *full* description of the photometer referred to by "Electron" and used by the Board of Works may be obtained.

"Electron" seems to have a greater liking for the Jablochkoff system than other newer ones. A week or two ago when at the Paris Exhibition I very carefully observed the many and varied systems, and I came to the conclusion that the Jablochkoff certainly was not the whitest, purest, or most economical light. Although simple in itself, it requires a larger expenditure in extra cables than other English and American systems. Trusting that other readers may give "Electron" and myself the benefit of their experiences,

I remain, yours truly,

JOHN E. CHASTER.

35, Ward's Buildings, Deansgate, Manchester.
Nov. 4th, 1881.

New Patents—1881.

4771. "Improvements in the method of and apparatus for lighting by gas, parts of the improvements being applicable to lighting by electricity and for heating purposes." C. CRASTIN. Dated November 1.

4775. "Electric lamps." H. A. BONNEVILLE. (Communicated by L. Daft.) Dated November 1. *Complete.*

4777. "Electric lamps." E. R. PRENTICE. Dated November 1.

4778. "Incandescent electric lamps." F. WRIGHT. Dated November 1.

4780. "Improvements in insulating electric conductors and in the material employed for such insulation or for water-proofing purposes." A. F. WOODWARD. Dated November 1.

4781. "Improvements in insulating electric conductors and in the material employed for such insulation or for water-proofing purposes." A. F. WOODWARD. Dated November 1.

4792. "Improvements in switches or apparatus employed in connection with electric lamps for closing the circuit on the extinction of one of the lamps, and for lighting and extinguishing the lamps, which improvements are also applicable to other similar purposes." W. E. HUBBLE. (Communicated by J. M. A. Gerard-Lescuyer.) Dated November 2.

4797. "Telegraphic or telephonic cables and conductors." C. L. GORE. Dated November 2.

4812. "Apparatus for using electric lamps on locomotives and other vehicles." H. J. HADDAN. (Communicated by W. De Busscher.) Dated November 3.

4819. "Motors actuated by electricity." W. L. WISE. (Communicated by E. Bürgin.) Dated November 3.

4820. "Electric lamps or regulators." W. L. WISE. (Communicated by E. Bürgin.) Dated November 3.

4824. "Electric current meters." C. A. CARUS-WILSON. Dated November 3.

4825. "Means or apparatus for regulating dynamo-electric machines or other sources of electricity and electric motors." C. A. CARUS-WILSON. Dated November 3.

4830. "Improvements in and relating to boats to be propelled by gas or other motors contained therein, and in apparatus for controlling or regulating, by the aid of electricity, the propulsion, steering, and other operations required in working the same, which apparatus is partly applicable for other purposes." W. R. LAKE. (Communicated by J. L. Lay.) Dated November 3.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1881.

1206. "Electrical apparatus for automatically recording the times of signals given or received." R. R. HARPER. Dated March 19. 6d. Relates to improvements in electrical apparatus for automatically recording or registering the times of signals given or received, applicable for use on railways and for other registering purposes. A dial or drum of paper or other material is used in connection with and driven by an ordinary clock or time-piece and according as the clock is an eight day or daily clock, so is this dial or drum marked off on its surface into days, hours, or minutes, or only into hours and minutes. At a particular point of the said dial, face, or drum, an electro-magnet is fixed, and at this point the time marked on the said dial or drum is always the same as that indicated by the clock. This electro-magnet is actuated by an electric current caused to pass through it by reason of a contact-piece in or on the instrument used in signalling being brought into electrical contact, and so completing an electrical circuit. The effect of the passage of this current is to cause the said electro-magnet, by the sudden attraction of an armature or other action, to puncture (or mark with a pencil or pen, or with the current of electricity, as in Bains' chemical telegraphy) the dial or drum at the said point, and so mark the exact time at which the signal was given.

1232. "Electric lamps." H. E. M. D. C. UPTON. Dated March 21. 2d. Relates to incandescent electric lamps. The object of the invention is to provide for the automatic feed of the carbon in a simple manner. For this purpose the end of a vertical carbon is rested upon two studs or rollers, which are the terminals of the conductors to and from the lamp, the carbon bearing on those studs by its own weight and sinking downwards as its lower portion becomes consumed. The electricity passing from the one stud to the other through the lowest part of the carbon heats it to incandescence, thereby producing illumination. The carbon may be pressed against the studs by a weight or spring, and in that case it may be directed upwards or at any desired inclination. (*Provisional only.*)

1235. "Apparatus for electric lighting." G. A. TABOURIN. Dated March 21. 6d. Relates chiefly to a new mode of lighting a larger or smaller number of lamps from a common source. Instead of transmitting and dividing the energy required for lighting the lamps by means of cables and conductors of electricity, compressed air or other suitable fluid is used in the following manner:—An air compressor (if air is used) driven by water, steam, or other motive power, and a receiver for compressed air are placed at the distributing centre, from which air pipes lead to the various points where dynamo-electric machines are situated, driven by compressed air by means of a small Brotherhood engine or any other suitable pneumatic motor. A dynamo-electric machine driven by compressed air is used for every lamp or for every small group of lamps, thereby avoiding the necessity of *dividing* the electric current.

1236. "*Electric* lamps," &c. J. A. BERLY. Dated March 21. 8d. Relates to the construction of electric lamps, candles, candle holders, switches, or commutators based on new principles and improved methods. Figs. 1 and 2 illustrate the principle of the invention.

Fig. 1.

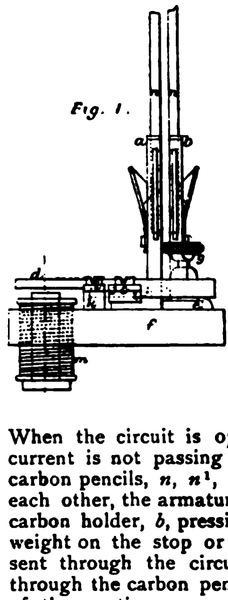
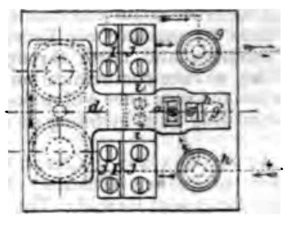


Fig. 2.



When the circuit is open, that is to say, when the current is not passing and the lamp is at rest, the carbon pencils, *n*, n^1, are apart from and parallel to each other, the armature, *d*, and its attached movable carbon holder, *b*, pressing by the effect of their own weight on the stop or rest, *e*. On the current being sent through the circuit, the current finds no issue through the carbon pencils, *n*, n^1, but follows the path of the continuous route opened to it through the electro-magnet, *m*. The magnetism of the magnet, *m*, attracts the prolonged armature, *d*, and the oscillating motion thus given to the said armature round its elastic spring hinges, *o*, causes the movable carbon pencil, n^1, to approach the fixed one, *n*, until their point or extremities come in contact, at which moment another path is open to the current, and as the resistance of the electro-magnet, *m*, is calculated to be very much greater than the total resistance of the candle and voltaic arc, the current leaves the magnet to choose the less resistant path, and by so doing the electro-magnet, *m*, relieves its armature, *d*, and the weight of the said, together with its attachment, causes the movable carbon pencil, n^1, to recede from the fixed one, *n*, and a gap being thus produced between the points, the candle is kindled, and the voltaic arc spreads and keeps at the point until the carbon pencils are consumed, or the circuit is open either accidentally or otherwise. In this latter case everything remains in the same position until the reinstatement of the current or relighting of the lamp by the closing of the circuit, when the same things happen in the same order as before, that is to say, the movable carbon pencil approaches the fixed one, their points touch, the movable carbon pencil then recedes from the other, and the light is produced. When the light is burning the armature and its attachment of movable carbon holders is in a perfectly fixed position, as it is resting on *e* by the effect of its own weight, and there can be therefore no vibrating motion imparted to it by the alternations of the current, as it is the case when the said armature and its attachment have to be maintained in their working position by the attracting force of the electro-magnet. The light is therefore perfectly fixed, and at the same time perfectly silent, as when the lamp is at work there is no part to which a vibrating motion could be imparted.

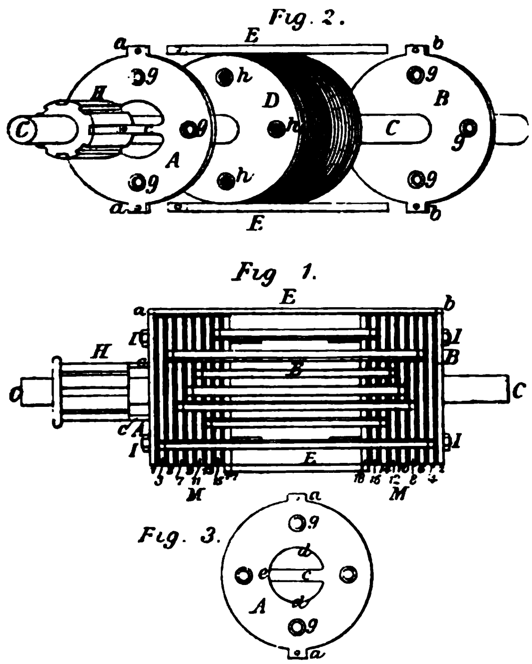
1240. "Armatures for electric machines." E. G. BREWER. (A communication from abroad by Thomas

Alva Edison.) Dated March 21. 6d. The object of this invention is to furnish a means of removing and replacing one or more coils of the armature of a dynamo machine. For the active or generative portions of the armature, coils of wire or naked bars are used, electrical connection from face to face being made through discs as hereinafter described. If each longitudinal set of wires or each bar be considered as one coil a series of discs equal in number to half the coils is used at each end of the armature. These discs are made of sheet metal, preferably copper, and are separated each from the other by a layer of insulating material, such as mica, paper, asbestos, or wood veneer. Those of each series are fastened together by bolts passing through holes in all the discs of the series, the bolts being insulated therefrom by insulating washers. The bolts take into screw holes in the ends of the armature itself, so that they not only bind the members of a series together but also secure the series to the armature itself. For the non-commutator end of the

Fig. 2.

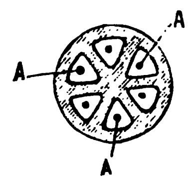
Fig 1.

Fig. 3.



armature the discs are made of sheet metal perforated in the centre to admit of the armature shaft passing therethrough, but insulated therefrom. Upon opposite sides of each disc is left a lug or ear by which the disc is attached to its proper bars or wires, so that the circuit at that end is completed between the two diametrically opposite bars or coils. For the commutator end the discs are made of sheet metal, each disc having two ears or lugs upon its periphery for attachment of the wires or bars which it is desired to connect at that end. Near the centre two semi-circular pieces of the metal are cut out, leaving a metal tongue between them, which tongue is cut away from the body of the disc at one end, and then bent outwardly at right angles. The tongue so bent is carried to the commutator block forming the connection of the disc thereto. The lugs or ears upon the discs at this end of the armature are not diametrically opposite to each other, but are so arranged relatively to each other and to the tongue referred to, and the coils or bars are so connected to the series of discs that all or nearly all the coils or bars are constantly in circuit. Fig. 1 shows the series of discs upon the armature shaft. Fig. 2 is a perspective view, showing the elements of the armature. Fig. 3 is an elevation of a disc for the commutator end; C is the armature shaft upon which is mounted the armature core, D, formed of sheet iron discs separated from each other by thin insulating sheets; B is an individual disc of the series, M[1], for the non-commutator end made of sheet metal with lugs or ears, *b*, *b*, thereon; A is an individual disc of the series, M, of the commutator end provided with lugs, *a*, *a*. In each are cut the two semi-circles, *d*, *d*, between which is left the tongue, *c*, which is cut loose from the body of the disc at *e*. This tongue is bent outwardly and fastened to the commutator base, H. The commutator, H, is formed of an insulating cylindrical body of one piece mounted upon the axis of the armature, and with grooves in its face equal in width to the tongue, *c*. The discs, A, are arranged upon the shaft so that each has its tongue, *c*, opposite the proper groove in H; the tongue is then bent outwardly and secured in its proper groove. This is clearly shown in fig. 2, where the tongue, *c*, of one disc, A, is shown as connected to H; the others, as many as are used, are connected in the same way in proper order to H, two being shown in fig. 1, the others being omitted so that the drawings be not obscured. Bolts, I, pass through holes, *g*, in the discs, but are insulated from the body of the discs, the discs being insulated from each other. The inner ends of the bolts are screw-threaded, and take into screw holes, *h*, in the body of the armature, thereby securing the discs together, and the assemblage of discs to the armature. Appropriate discs of each series are connected in pairs by the coils or bars, E, E, bars being preferable, the attachment of discs and bars being made by screws passing through the lugs into the bars. For instance, upon the side shown, discs 1 and 2, 3 and 4, 5 and 6, 7 and 8, 9 and 10, 11 and 12, 13 and 14, 15 and 16, 17 and 18 are connected. Upon the side not shown the connections would be different, the lugs, *a*, *a*, and tongue, *c*, of each disc being so arranged relatively to each other that all or nearly all the coils shall be always in circuit.

1257. "Laying telegraph wires." SYDNEY PITT. (A communication from abroad by W. B. Espeut, of Spring Gardens, Buff Bay, Jamaica, West Indies.) Dated March 22. 6d. An iron tube is lined inside

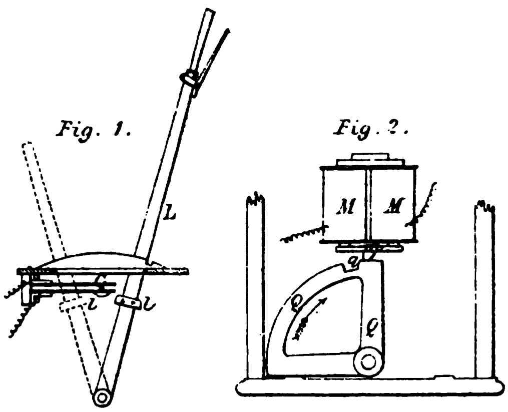


with porcelain, such lining being formed in one or more longitudinal compartments as desired. The figure is an end view of a tube such as is employed according to this invention for containing telegraph wires; *a*, *a*, *a*, are the telegraph wires lodged in the several compartments of the tube.

1453. "Interlocking of railway telegraphic block instruments," &c. CHARLES HODGSON. Dated April 2. 8d. Relates to the improvements in the construction and arrangement of signal apparatus, whereby is effected the interlocking of the instruments at a signalling station with each other, and with those at another

station to provide against negligence in the use of these instruments, and to transmit the necessary electrical currents for working them in both directions along a single line wire.

Fig. 1 represents one of the levers for working a point or signal, and fig. 2 represents part of a block instrument having in it the locking shaft, S. On this shaft is fixed a quadrant arc, Q, having a notch, *q*. Immediately above is fixed an electro-magnet, M, the armature, *m*, of which is held up by attraction, while an electric current passes through the coils of M, the quadrant, Q, and the shaft, S, being in that case free to be moved. On the lever, L, fig. 1, is fixed a piece,



l, which, when the lever is moved over to the dotted position, passing a protuberance from one of a pair of contact springs, C, causes them to make contact, and so to short-circuit the electricity that was passing through the coils of M. By this short-circuiting the magnet, M, loses its attractive power on the armature, *m*, which whenever the notch, *q*, presents itself under it drops into that notch, and so prevents the movement of the quadrant, Q, and shaft, S, in the direction of the arrow. Thus the movement of the lever, L, locks the locking shaft, S, and causes all the levers and instruments connected to S to be retained in the condition in which they were before the lever, L, was moved. Such locking of the shaft, S, and of all connected with it, instead of being effected by the movement of a lever may be effected by the movement of the signalling commutator from one of its positions to the other. In this case the plunger of the commutator when it is in one position, can give certain signals, but in order to give other signals it has to be moved to a second position. In passing from the one position to the other it acts on contact springs, short-circuiting the electric current in the same manner and with the same effect as above described with reference to figs. 1 and 2. When the movable commutator is in the position where it can be employed to signal "line clear" it is arranged that its plunger should be prevented from being more than once pressed in for the purpose of signalling, otherwise the attendant might by negligence permit more than one train to occupy a section of the line at one time.

The following are the final quotations of stocks and shares for Nov. 11th.:—Anglo-American, Limited, 52-52½; Ditto, Preferred, 81-82; Ditto, Deferred, 23-23½; Brazilian Submarine, Limited, 11⅛-11⅝; Brush Light, *£4 paid, 7¾-8¼; Ditto,* £10 paid, 17-18; Electric *Light, 1⅛-1⅝;* Consolidated Telephone Construction, ⅞-1⅛; Cuba, Limited, 9¼-9¾; Cuba, Limited, 10 per cent. Preference, 16-17; Direct Spanish Limited 5-5½; Direct Spanish, 10 per cent. Preference, 14½-15½; Direct United States Cable, Limited, 1877, 10¾-11¼; Debentures, 1884, 100-103; Eastern Limited, 10-10½; Eastern 6 per cent. Preference, 12⅞-13⅜; Eastern, 6 per cent. Debentures, repayable October, 1883, 100-103; Eastern 5 per cent. Debentures, repayable August, 1887, 100-103; Eastern, 5 per cent., repayable Aug., 1899, 105-108; Eastern Extension, Australasian and China, Limited, 11-11½; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 108-111; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 103-106; Ditto, registered, repayable 1900, 103-106; Ditto, 5 per cent. Debenture, 1890, 99-102; Eastern and South African, Limited, 5 per cent. Mortgage Debentures, redeemable 1900, 102-105; Ditto, ditto, to bearer, 102-105; German Union Telegraph and Trust, 10½-11; Globe Telegraph and Trust, Limited, 6½-6¾; Globe, 6 per cent. Preference, 12½-12¾; Great Northern, 12-12⅛; 5 per cent. Debentures, 103-106; India Rubber Company, 23½-24½; Ditto, 6 per cent. Debenture, 104-108; Indo-European, Limited, 27⅛-28⅛; London Platino-Brazilian, Limited, 4-5; Mediterranean Extension, Limited, 2½-3; Mediterranean Extension, 8 per cent. Preference, 9½-10; Oriental Telephone, ⅜-⅝; Reuter's Limited, 12-12½; Submarine, 290-300; Submarine Scrip, 2⅜-2⅞; Submarine Cables Trust, 98-101; United Telephone, ——; West Coast of America, Limited, 4¼-4¾; West India and Panama, Limited, 1¾-2; Ditto, 6 per cent. First Preference, 7½-8; Ditto, ditto, Second Preference, 6¼-6¾; Western and Brazilian, Limited, 6¾-7¼; Ditto, 6 per cent. Debentures "A," 110-115; Ditto, ditto, ditto, "B," 97-101; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 123-128; Ditto, 6 per cent. Sterling Bonds, 104-107; Telegraph Construction and Maintenance, Limited, 28¾-29¼; Ditto, 6 per cent. Bonds, 104-108; Ditto, Second Bonus Trust Certificates, 1⅛-1⅜.

TRAFFIC RECEIPTS.

NAME OF COMPANY.	SEPT.	OCTOBER	REMARKS.
	£	£	
Anglo-American... 1881	...	..	From July the publication of the receipts of this company are suspended.
1880	..	..	
Brazilian S'marine 1881	14,841	12,909	
1880	*13,585*	*14,101*	
Cie. Française ... 1881	...	...	
1880	..	..	Not published
Cuba Submarine... 1881	2,000	2,300	
1880	*1,710*	*2,102*	
Direct Spanish ... 1881	1,790	2,063	
1880	*1,537*	*1,881*	
Direct U. States... 1881	...	...	From July the publication of the receipts of this company are suspended.
1880	..	..	
Eastern 1881	47,407	48,872	
1880	*41,717*	*45,570*	
Eastern Extension 1881	30,866	31,164	
1880	*28,771*	*29,061*	
Great Northern ... 1881	22,280	21,160	
1880	*22,320*	*22,480*	
Indo-European ... 1881	...	...	
1880	..	..	Not published.
Submarine 1881	...	...	Publication temporarily suspended.
1880	..	..	
W. Coast America 1881	...	...	
1880	..	..	
West. & Brazilian 1881	9,530	..	
1880	*9,375*	..	Not published.
West India 1881	3,964	3,848	
1880	*1,384*	*2,872*	

THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. IX.—No. 213.

THE PARIS ELECTRICAL EXHIBITION.

THE BRITISH SECTION.

THE INDIA-RUBBER, GUTTA-PERCHA, AND TELEGRAPH WORKS COMPANY.

TORPEDO APPARATUS.

(*Continued from page* 452.)

"ELECTRO CONTACT SYSTEM." Beyond the three converging lines of torpedoes, shown in fig. 1 (page 449) are three groups of mines to protect the entrance to the harbour; these are fired solely by *circuit-closers* contained in the buoyant torpedoes and actuated, as the name of the system implies, by direct *contact* with the hostile vessel.

Branch cables connect the four torpedoes of each group with the *junction box*, J', where they are joined, through *disconnectors*, to a single-core cable, reaching to a second junction-box nearer in-shore; here the three main conductors are made up into a multiple cable, communicating with the firing-station on shore. A *signalling and firing instrument*, similar to that already described, is joined up in circuit with each of the three main conductors; this instrument switches in the *firing battery* and indicates the particular group to which an exploded torpedo belongs.

The *circuit-closer* (fig. 5), known as *Mathieson's improved circuit-closer*, consists of a *coiled tapering spring*, which carries a *contact-disc*, D, through the centre of which rises a spindle, surmounted by a brass ball. The *contact-disc* is connected to a platinum wire fuze, and to the cable by a wire, *h*, but is insulated from the spring and spindle by an ebonite ring. The apparatus has three adjustable contact screws, equi-distant from each other, and set opposite to springs, *e*, the latter being connected through the base of the instrument with the metal of the buoy inclosing it, so as to make a tolerably good earth. It is usual to adjust the contact screws so that, when the instrument is held in a horizontal position, they are just short of touching the earth springs. Thus adjusted, the circuit-closer is unaffected by the regular undulating motion of the waves, but should a passing vessel strike the torpedo, the concussion sets the circuit-closer oscillating violently, and repeated contacts are made between the *contact-disc* and the earth springs, thus completing the circuit continually and allowing a current from the firing battery to pass.

The employment of a *coiled tapering spring* secures very much more prolonged contacts than was the case when a steel rod was used, as was formerly the case, and it has enabled Mr. Mathieson to reduce the weight of the ball at the top of the spindle from 2½ lbs. to 9 oz.

Fig. 6 is a vertical section of a buoyant torpedo with the circuit-closer, fuze, and bursting charge complete; it is a pear-shaped buoy, with a wooden jacket strengthened with hoop-iron, and has a galvanised iron lining. The circuit-closer and fuze at K are placed before a bursting charge of 2 lbs. of dry gun cotton at R; and the whole is inclosed in a gun metal shell to exclude moisture. One wire of the fuze is joined to the conductor of the cable which enters the torpedo from below, and the other wire is connected to the *contact-disc* of the circuit-closer. The interior of the torpedo is filled with damp gun cotton.

As a torpedo bursting near a vessel is considerably more destructive when it is in actual contact with the latter, than when it is submerged at a distance below the surface of the water, it is found necessary to employ 500 lbs. of gun cotton in the latter case, while 100 lbs. suffice for surface charges. On the other hand, torpedoes moored as in fig. 9 (page 491) command a wider area and are, on that account, more suited for the *firing by observation system*. They must, however, be moored at a greater distance apart (generally not less than 300 feet) so that the bursting of one torpedo may not explode its neighbour.

The two conductors of the *platinum wire fuze* (fig. 7) pass through an ebonite plug and have their ends tinned and bridged across by a fine platinum wire ·003 inches in diameter and one quarter inch long. Around the platinum wire bridge, inside *b*, is a small quantity of granulated gun cotton, and above it rises a tube, *o*, containing *fulminating mercury*, which is inserted into the bursting charge, R, fig. 6.

When the buoy containing the circuit-closer receives a violent blow, the circuit is closed and the current from the firing station heats the platinum wire, this ignites the granulated gun cotton, fires the fulminating mercury, and explodes the mine.

Since all the mines in the system are fired by the same *signalling battery*, it is evident that when one torpedo is exploded, the battery would be *to earth* through the shattered end of the cable. To obviate this defect, Mathieson's disconnector (fig. 8) is introduced into each of the branch circuits at the junction box, J. It consists of an ebonite plug, *e*, through which pass two india-rubber covered wires, the latter and the ebonite being *cured* together to form a solid, so as to effectually prevent any moisture finding its way along the wires, even under pressure.

The ends of the wires are tinned and bridged across by a fine platinum wire, *b*, ·003 inch in diameter, and about one quarter inch long, as in the case of the platinum wire fuze (fig. 7). Immediately around the *bridge* is a film of gun cotton, and below it and between the copper conducting wires is a tube, *t*, containing a slow fuze. A small cap, *c*, containing granulated gun cotton, is fitted over the platinum wire, and the whole is encased in a cast-iron shell, *g*, the interior of which is made perfectly water-tight by a gutta-percha washer, *w*, placed between the cover and the base to which it is screwed. When the circuit is completed by a vessel striking the circuit-closer, the current from the firing station fires the fuze in the torpedo, and at the same time heats the platinum wire of the disconnector in the junction box, and so fires the

granulated gun cotton. This in turn ignites the slow fuze, *t*, which, being very cross grained, mechanically ruptures the platinum wire *bridge* and severs the branch circuit from the system. The cast-iron shell is made sufficiently strong, and has space large enough inside, to admit of the gas, generated by the ignition of the gun cotton, expanding without receiving injury, so that perfect insulation at the break is secured.

It is, of course, essential that the torpedo be exploded before the *disconnector* cuts out the branch circuit; and this is brought about by the slow fuze, *t*, which allows an appreciable time to elapse after the platinum wire *bridge* is heated, before fulfilling its function. Another method of breaking the platinum wire is to insert a wooden pin through the small ebonite cap, *e*, between the copper conductors and below the *bridge*, so that when the cap is forced off by the gas expanding, the pin is carried with it and breaks through the platinum wire. In

FIG. 5.

FIG. 11.

FIG. 6.

FIG. 8.

FIG. 7.

FIG. 12.

this case the action of the disconnector is retarded by using a platinum wire of rather larger diameter than that used for the fuze, so that the latter becomes heated first. The importance of some such simple and effectual means of cutting out a circuit is obvious, as without it it would be necessary to employ a separate conductor for each torpedo.

Fig. 11 shows the interior of a *junction box* for the *main* cable, C, and four branch cables, *b*. On a small platform inside are holes, into which four *disconnectors*, one for each branch circuit, are fitted; one wire of the disconnector is joined to its branch conductor and the other to a plate, *n*. In the centre is a brass plate, C, to which the main cable is attached, and which overlaps the four plates, *n*, so that it may be connected to them by thumb-screws. Should it become necessary to raise the junction box at any time for testing purposes, this commutator enables the electrical condition of the branch circuits to be ascertained separately, or any one to be disconnected from the main cable by unscrewing the corresponding screw.

It is of importance that the firing of torpedoes be controlled from the shore when practicable, so that they may be rendered safe for the passage of friendly vessels by disconnecting the *firing battery*. In certain cases, however, as for instance, when blockading a harbour or protecting channels, what are known as *electro-mechanical torpedoes* are made use of. This system differs from the *electro contact system* only in employing a *submarine battery*, fig. 12. The torpedo with its *circuit-closer* is first moored with a sinker, and the electric cable towed to a safe distance, when the submarine battery is attached and gently lowered into a position where it may be recovered at will.

FIG. 13.

Fig. 13 is a sketch of a torpedo explosion, drawn to scale from a photograph taken when the column of water was at its highest elevation. The torpedo contained 432 lbs. of gun cotton, submerged 27 feet under water; the height of the column measured 81 feet, and the diameter at the base 132 feet.

FIG. 3.

On either flank of our imaginary harbour, fig. 1, (page 449) are laid down some purely mechanical torpedoes, M, M, to complete the line of defence, but as these are not of an electrical nature, they are beyond the scope of the present article. Indeed, submarine warfare has developed of late years into

a distinct science, and has been so perfected in all its details, that we have only attempted to give a general outline of the most approved electric systems at present in use.

Fig. 3, which we give here, shows the "*converging arc*," which was alluded to in the first portion of the article, but which was then accidentally omitted.

[For many of the details in the above article, we are indebted to Mr. J. Rymer-Jones, of the India-Rubber, Gutta-Percha and Telegraph Works Company, who has also kindly furnished us with the drawings.—ED. TEL. JOUR.]

FOREIGN SECTIONS.

(*Italy.*)

PACINOTTI.

THE pieces of apparatus sent by Antonio Pacinotti to the International Exhibition of Electricity in Paris in 1881, are the following :—

1. A small electro-magnetic and magneto-electric machine, with an electro-magnet transverse to the ring, constructed in 1860.

2. A magneto-electric machine, with an electro-magnet transvers to the coil, to be moved by hand.

3. A magneto-electric machine, with a transverse electro-magnetic fly-wheel, to be moved by a driving-belt.

4. Pair of discs for the study of the electricity developed by molecular attraction.

We will give as briefly as possible a description of these pieces of apparatus :—

1. The little electro-magnetic and magneto-electric machine, which is shown by fig. 1, has an electro-magnet transverse to the ring ; it was constructed by Pacinotti in 1860, and in its construction (which was done at the expense of the Cabinet of Technological Physics of the University of Pisa) Pacinotti was assisted by the mechanician Guiseppe Paggioli. Although already somewhat old, this apparatus has been sent to the Exhibition to put in evidence the priority of Pacinotti, as against M. Gramme, in the construction of electro-magnets transverse to the ring, and in their use, both for obtaining mechanical work from the electric current and for obtaining a continuous induced current from mechanical work. In the part of the journal *Nuovo Cimento* for June, 1864, there was published by Pacinotti the design * of the machine with the description ; a theoretical explanation and some notices of the experiments performed both for obtaining work and for obtaining a continuous induced current, were also given. Of this publication, moreover, there were separate copies struck off and distributed in Paris in 1865.

In the palace of the Exhibition, and in presence of the jury, the old machine has acted not merely as an electro-magnetic machine, putting itself in rotation when a current was sent through it, but it has also acted as a magneto-electric machine when made to turn by hand ; it has effected the deviation of a galvanometer needle by the continuous induced current which it produced.

The principal value of the little machine constructed by Pacinotti in 1860 consists in the following arrangement, which constitutes the principle of the transverse electro-magnet. One end of the wire of each of the numerous electro-dynamical bobbins, which in this machine cover the light wire ring, is connected with the beginning of the wire of the next bobbin by means of the corresponding contact-piece of the commutator. The polar armatures extended in the fixed inducing-magnet, the teeth in the light iron ring, the brass cross-piece of the support, and the double range of contacts in the commutator, are other peculiarities in the apparatus. It may be mentioned that the friction-wheels on the commutator were used by Pacinotti to diminish the friction when the machine was worked with a small motor ; but that in the first experiment, when the machine was adapted to give the induced current, it was moved by hand in preference to adapting friction-wheels upon the commutator to diminish the resistance to the passage of the electric current. The compensation disc bearing these friction-wheels figures among the objects exhibited.

In the description of the Gramme machine, given by M. Gaugain (the construction of the first apparatus), in *Annales de Chemie et Physique*, March, 1873, friction discs are shown, which greatly recall the wheels in the Pacinotti machine.

2. Pacinotti, in September or October, 1873, constructed the magneto-elecric machine, shown by fig. 2, which has an electro-magnet transverse to the coil ; this machine had a light electro-magnetic coil, which was applied in some experiments by means of a temporary support. In 1874, the machine was arranged with a fixed electro-magnet, and there was published in the *Nuovo Cimento*, in the part for September and October, 1874, a notice of the construction and of the experiments performed.

The electro-magnetic bobbin is not a simple modification of the dimensions of the core and of the electro-dynamic coils which covered the ring of the machine of 1860 ; the wire of each coil, in place of passing within the ring, passes to the opposite part of the core, the mode of communication, which is the leading feature, remaining unchanged.

Pacinotti when constructing his electro-magnetic bobbin, did not know that so simple a modification had been made by Alteneck ; nevertheless, the machine of Pacinotti differs from that of Alteneck in various particulars, among which may be remarked the following : The iron core of the electro-magnetic bobbin of Pacinotti is composed of discs of iron strung on an axle of rotation and joined by means of lac varnish, so as to prevent the circulation of induced currents upon the core : further, these discs are toothed so that the conducting wire is stretched right from one coil to the other ; this not only renders the iron more susceptible to magnetic changes, but it also renders the construction more durable, since the turns of the conducting wire are thus protected from friction against one another. Another common peculiarity, which is indicated in the notice published in the year 1874, is the possibility of getting a greater amount of current by having upon the commutator

* For copies of these designs see TELEGRAPHIC JOURNAL for July 1, 1879.

FIG. 1.

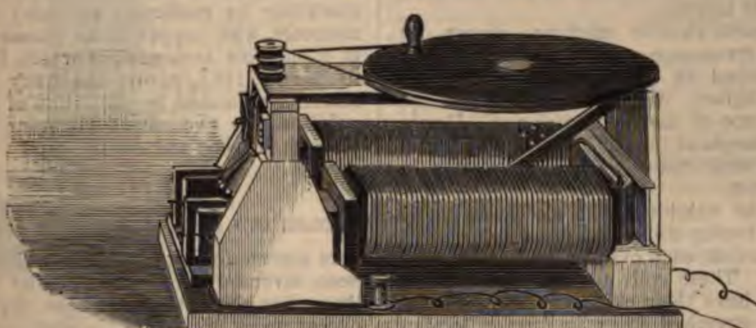


FIG. 2.

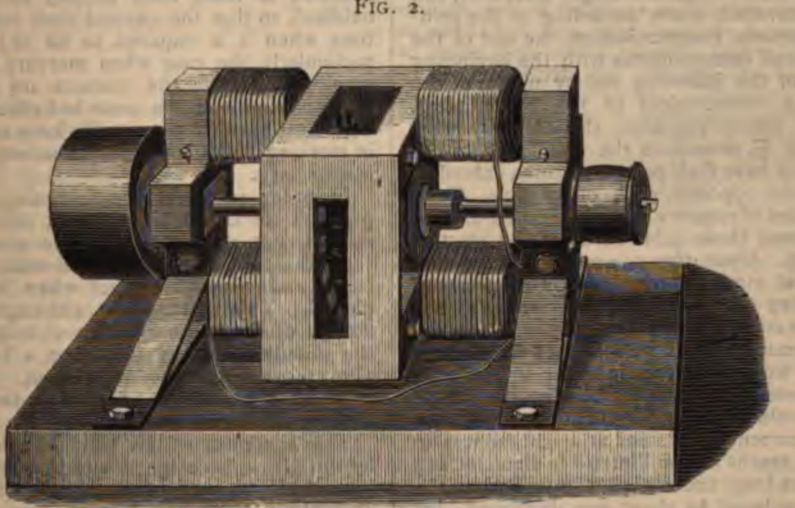


FIG. 3.

four contact-breakers, in place of two only; one pair of such contact-breakers are on the diameter normal to the influencing poles, and the other is placed in the width of two contact-pieces in the direction of rotation.

The movable contact-breakers receive the outside current, whilst the normal contact-breakers are connected to the fixed magnet, and direct into it a current in the direction which produces the increase of the magnetism. Thus the arrangement of the machine, as regards its movements, is formed on the conditions of a stable equilibrium. The contact-breakers used by Pacinotti in this machine differ from those generally in use, in that the wire brushes instead of pressing against the commutator with their sides do so with their points, so that as they wear they are not sensibly injured. The dimensions of the machine are not great, its weight is only 30 kilos.; the support, though partly of wood, is strong. When the machine is turned by one man it gives an external current equivalent to that of two or three Bunsen elements; but by adding a driving band to a ring and employing several men to move the machine, it then produces much stronger currents.

In the Exhibition the current given by this machine has generally been used to put the foregoing machine in motion.

3. The magneto-electric machine, shown by fig. 3, has a transverse electro-magnetic ring; it was constructed in the spring of 1878 by Pacinotti at Cagliari, in the Doghio workshop, with the assistance of the mechanician, G. Dessi; but the first attempts at the construction of electro-magnetic rings were made by Pacinotti at Pisa in the spring of 1875.

In the machine exhibited, the electro-magnetic ring consists of twenty coils of copper wire, covered with silk and varnish, each of them having the form of the letter D. These coils are united to the axle of rotation and have their circular parts laid upon each other and stretched so as to form a kind of ring. Such electro-magnetic rings, moreover, can be called transversal, since, according to the principle of transverse communication, the end of the wire of each coil communicates with the beginning of the wire of the following coil by means of the corresponding contact-piece of the commutator. Two large electro-magnets, shaped somewhat like the letter E, constitute the fixed part of the machine; they have their polar armatures extended, and are placed opposite each other thus, E Ǝ, with their poles of contrary name presented to each other. Between these poles revolves the electro-magnetic ring. Upon the commutator there are, as in the first machine, four contact-breakers, of which two give the magnetising current, and the other two the current for external use.

This ring machine was in action at Cagliari, in the Doghio workshop, and in order to move it, about one horse-power was used. The ring made about 600 revolutions per minute at first, and then the external current maintained at bright redness an iron wire, six-tenths of a millimetre in diameter and 25 centimetres long, and caused it to fuse when the length was reduced to about one decimetre; between carbon points the machine maintained a very good electric light. The total weight of the apparatus was a little more than a hundred kilos.

4. Besides the machines, Pacinotti exhibits discs and couples for generating electricity by molecular friction; an account is given of their use in two memoirs contained in the *Nuovo Cimento* for 1875. By means of this apparatus, Pacinotti has proposed to show that the friction between the molecular elements, kept in agitation by thermic movements, are the causes, of the electromotive force occasioned by contact, of the chemical action, and of thermo-electricity. In the memoir of 1875 he begins by noticing analogies between the developments of electricity by molecular actions, and of friction between bodies. Between the objects exhibited is a numerous collection of bi-metallic pairs, well insulated, which, if rubbed upon plates of ebonite, or of other non-conductors, leave traces of electricity, which can be recognised by means of the electroscopic dust of red lead and sulphur. There are also, among the objects shown, three discs of zinc and one disc of copper, fitted with insulating handles, with set-screws, and with connecting clamps, two of which are coated with paraffine. These discs form part of a much more numerous collection, which Pacinotti made use of in studying the electrophoric action in the disc experiments of Volta.

Finally, among the objects exhibited (in connection with the numerous couples for producing electricity by molecular attrition) is a small actimometer, with copper plates immersed in sulphate of copper, an arrangement which Pacinotti began to use in 1863, during the study of the electric currents generated by the action of heat and light, published in two short memoirs in the *Nuovo Cimento* for 1863 and 1864.

(*France.*)

GAULNE AND MILDÉ'S ELECTRIC FIRE SIGNALLER.

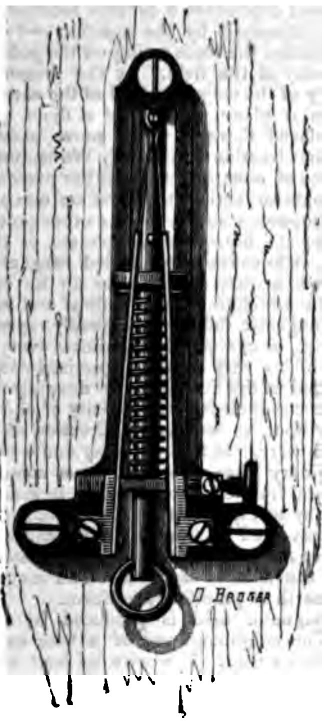
THE automatic fire signallers which have hitherto been invented have possessed the possible defect that when the apparatus is not required to work, except under accidental circumstances, and at long intervals of time, their contact surfaces become oxidised, so that the current does not pass at the time when it is required to do so; this is more particularly the case when mercury contacts are employed. When the contacts are made with an inoxidisable metal, the same bad effect takes place, from dust or other causes. To keep such apparatus in working order continual attention and cleaning is necessary.

In order to avoid the foregoing defects, the principle of keeping the circuit closed normally, and of rupturing it to give the alarm, has been suggested; for this purpose a bi-metal plate, which bends *away* from a contact when heated is employed. This arrangement, although it avoids the defects of the ordinary open circuit method, has the disadvantage of requiring a battery to be always working, and, moreover, it requires a number of indicators, in order that the exact locality of the fire may be able to be announced.

The apparatus of M. Gaulne, which is shown by the figure, is designed with the object of avoiding all the defects of the inventions previously devised; it is, moreover, very inexpensive. The signallers take the place of the ordinary electric push button in the usual electric bell systems, in fact, are used for ordinary ringing purposes. In

this case, the current passes by the action of the person who requires to ring; when, however, a fire takes place, the apparatus works automatically.

The invention consists of a plate of metal, secured to the wall of the room near the ceiling by three screws. The leading wires of the apparatus are connected to metal terminals, fixed at the lower part of the whole. To each of the bosses of these terminals are secured straight compound metallic springs, formed of brass and steel; these springs, which form an acute angle with each other, have



their brass portions (which are on the outside of the angle) terminated a little distance short of the apex of the angle, but the steel portions are carried further up, and have their inner ends faced with platinum. These ends, although in close proximity to each other, do not normally touch. In the vertical axis of the plate, and behind the springs, is a rod, which slides vertically in guides; the lower end of this rod is terminated by a ring (to which can be attached the bell cord) and the upper end has a projecting pin, which rubs between the two platinum surfaces of the springs when the rod is pulled down. This rod is normally held up, and brought back into the position shown, by means of the spiral spring.

The action of the apparatus is obvious; when the rod is drawn down by means of the bell cord, the pin rubbing between the platinum contacts completes the circuit. If, on the other hand, a fire breaks out, the springs become heated and bend inwards until the contacts touch, and thus complete the circuit; in this case the lengthened ringing of the bell indicates that the cause is not due to the simple momentary pull of the bell cord. It is obvious that no amount of rough pulling of the cord can interfere with the sensibility of the springs, whilst the continual friction of the pins between the contacts, which results from the use of the cord, keeps the contacts clean.

In order that the apparatus may be set to ring at any required temperature, a set screw is provided, which regulates the distance between the contacts; this screw has an index hand, which moves round a dial graduated to thermometric degrees, so that the apparatus can be set to act at any required temperature.

ON THE PRACTICAL MEASUREMENTS OF ELECTRICAL MAGNITUDES.

By W. H. PREECE, F.R.S., Electrician to the General Post Office, London.

(*Continued from page* 467.)

WE propose to consider only one derived system, viz., the electro-magnetic system of c. g. s. absolute units, and to leave the question of the conversion of this system into another system for future consideration. I give in a foot-note those equations which are most frequently in request.*

10. This British Association electro-magnetic system of electrical units is well represented in the following table:—

Symbol.	Electrical quantities.	Nomenclature.	C. G. S. units
R.	Resistance	Ohm	10^9
E.	Electromotive force	Volt	10^8
K.	Capacity	Farad	10^{-9}
Q.	Quantity	(Ampère)	10^{-1}
C.	Current	Weber	10^{-1}

It will be seen in the c. g. s. system that the absolute units of resistance and electromotive force are so small, that very large numbers have to be used to bring them within practical limits. The units of quantity, current, and capacity are so large that fractions only can be used. Christening these units with names has had a happy practical effect. The only unit that has not yet had a name is that of quantity, and *Ampère* has been suggested† as one worthy to rank with the other illustrious names that have been applied so usefully. Symbols have been attached to each magnitude, and it would be a great convenience, especially to students, if physicists would invariably use the same symbols to represent the same quantity. The letter thus becomes a kind of short-hand symbol conveying at once the same idea as the

* *Fundamental Units.*

Length = L. Time = T. Mass = M.

Derived Mechanical Units.

Velocity = $V = \frac{L}{T}$. Force = $F = \frac{LM}{T^2}$. Work = $W = \frac{L^2M}{T^2}$.

Electro-Magnetic Units.

Magnitude.	*Symbol.*	*Dimensions of Unit.*
Quantity of Electricity	Q	$L^{\frac{1}{2}} M^{\frac{1}{2}}$
Electromotive Force...	E	$L^{\frac{3}{2}} M^{\frac{1}{2}} T^{-2}$
Capacity	K	$L^{-1} T^2$
Current	C	$L^{\frac{1}{2}} M^{\frac{1}{2}} T^{-1}$
Resistance..................	R	LT^{-1}

† Johnstone Stoney, British Association, 1874.

word. I insert those usually adopted in England, but the practice there is very varied, and authors seem to delight to confuse their readers by making free use of all the alphabet to indicate at different times the same quantity.

In the practical application of these units, multiples and fractions have to be largely used. Thus, while the ohm is a very convenient unit for ordinary "conductivity" measurements, it leads to the use of very high numbers when "insulation" has to be expressed. A multiple of the ohm is therefore used as an insulation unit; 10^6 ohms has been adopted for this purpose, and is called the *megohm*. On the other hand, the farad or the unit of capacity is too large, and $\frac{1}{10^6}$ of it, or the *microfarad*, is that used. The *weber* is much used for electric light and for the transmission of power purposes, but it is too large for telegraphic purposes, so that a fraction, the *milliweber* or 10^{-3} weber, is used as an useful unit, and for certain physical researches the microweber or 10^{-6} weber is sometimes used.

Index symbols similar to those used to indicate degrees of temperature, have also been suggested and are much used. The ohm is indicated by the Greek Omega ω, and the megohm by Ω; the weber is indicated by the Greek gamma, Γ, and the milliweber by the small gamma, γ. The other quantities might also be conveniently indicated in the same way. Thus, as 12° indicates 12 degrees, so 12^ω would indicate 12 ohms, 12^Ω 12 megohms, 12^Γ 12 webers.

11. Now such being the practical system of electromagnetic units, the question remains for discussion:—How can electrical magnitudes, which apparently seem so entirely independent of time, mass, and space, be measured by reference to their fundamental units? *Resistance* is the obstruction which matter opposes to the passage of electricity through it. Hence to measure resistance we must be able to measure the flow of electricity, or the quantity of electricity that passes in a given time through a conductor. The transference of electricity from one point of a conductor to another is invariably accompanied by work done or energy expended; for instance, magnets are moved, heat is generated, light is produced, or chemical decomposition is effected; so that to measure the quantity of electricity passing, in other words to measure *a current of electricity*, we must measure either the force it exerts upon a magnet in its immediate neighbourhood, or the amount of heat it produces, or of work it does in a given time.

We will consider the first method only, or the electromagnetic effect of Œrsted. Here we have a current of electricity acting upon a magnet so as to cause it to move, and before we can measure the force exerted by the current upon the magnet, we must be able to express the strength of the magnet itself in the same system of units.

12. It is the fundamental law of magnetism—the law of Coulomb—that unlike poles attract while similar poles repel each other with a force (F) which varies directly as the product of the intensity of magnetism of each pole (m, m'), and inversely as the square of the distance (d) separating them. This law is expressed by the formula:—

$$F = \pm \frac{m, m'}{d^2} \qquad (1)$$

— indicating attraction and + repulsion.

In other words, one pole exerts force on another pole, and if one pole repels a similar pole at a centimetre distance with the force of a dyne, that is, with such a force that the pole, if free, will move with a velocity of one centimetre per second, we have the unit magnetic pole, for if F be 1 and d be 1, m and m' must each be 1. The unit magnetic pole has not yet received a name. If one were wanted a better name than *Gauss* could scarcely be selected, unless it were that of *Coulomb*. But we may disregard the second pole, and confine ourselves to the space affected by the magnetism of the one pole. The neighbourhood of a magnet is called a *magnetic field*, and as the earth is regarded as an enormous magnet, any portion of space about its surface is a portion of its magnetic field, and the intensity of this field can be measured by the force with which a pole of a magnet is affected when placed there. In fact, the intensity of a magnetic field, is the force which unit pole experiences when placed there. If free to move, it would move with a defined velocity; if fixed, it would experience a definite tendency to move. This fact is expressed by the equation:—$f = m\,h$, (2) where f indicates the force acting on the pole m, and h is the intensity of the field. At the present moment the intensity of the magnetic field of the earth at Paris, in a horizontal plane, is ·1776 of a dyne, and if unit pole were placed there, it would move under the influence of that fraction of a dyne. We cannot conceive the existence of one pole without the presence of the other. Whatever action there be on one pole, there must be an opposite action on the other pole. Hence the effect of the horizontal component of the earth's magnetism, is to cause a suspended magnet to move about its fixed centre, and to take up its position in the magnetic meridian with a defined and measurable force. A magnetic field is graphically represented by drawing lines, or curves, which indicate everywhere the direction which a very small magnetised needle would take if moved in the field, and by drawing these lines to scale, we can indicate the intensity of the magnetic field at any spot, as well as the direction of the force experienced there. In fact, Faraday made such use of these imaginary lines, that they have come to be regarded as real lines of force, existing in space and determining physical questions. Thus a magnetic field is said to be traversed by lines of force, and when these lines of force are parallel, and at equal distances from each other, the field is *uniform*. The magnetic field due to the earth is practically uniform.

But a magnetic field is produced by an electric current. The neighbourhood of a wire conveying a current is such a field. If a wire be bent in a circle, and a current traverse the wire, then the centre of that circle will possess a magnetic intensity which is easily measured. In fact, if we take a circle of one centimetre radius, and cause a current to flow along an arc of one centimetre length of this circle, this current can be adjusted so as to exert unit force on unit pole at the centre, and that current will be unit current, and it will produce a magnetic field of unit intensity at the centre. If the current circulates through the whole circumference of the circle it will exert 6·2832 units of force at the centre. This unit current is the c. g. s. unit current.

Hence currents can be measured by the forces they exert, and these forces being measured by the fundamental units, currents of electricity can be measured by the same system.

13. Now comes the question—How are currents of electricity produced? Currents are dependent upon but two quantities. *Electromotive force** and *Resistance* whose relations were determined by Ohm, and expressed by his well-known formula. Faraday showed that if a wire be moved through a magnetic field, in such a way as to cut the lines of magnetic force at right

* Electromotive force is the difference of electric pressure (potential) that determines the flow of electricity. It is an expression analogous to the difference of temperature that determines the flow of heat, and to the difference of level that determines the flow of water, and to the difference of pressure that determines the flow of air or gas.

an electromotive force will be determined in onductor, and a current will flow if the wire a closed circuit. The strength of this current pend upon the intensity of the magnetic field e length of the conductor (L), *the velocity with he conductor moves across the line of force* (V), resistance of the circuit (R). These relations en by the equation :—

$$C = \frac{VHL}{R} \qquad (3)$$

e if we have a uniform magnetic field of unit y (H = 1), and if the resistance of the circuit be = 1), then if the conductor of unit length (L = 1) hrough the lines of force at right angles to their n and to its own length with unit velocity (V = 1), ld have (C = 1) unit current. Hence current can measured by the velocity with which a wire through a magnetic field, and hence it is ent upon the fundamental units of time and

Having thus a measure of the current in terms of damental units, we have also a measure of the notive force and resistance of the circuit in the its. It is evident in Ohm's formula—

$$C = \frac{E}{R}$$

c be 1 and E be 1, R must also be 1. If we can e unit current in unit magnetic field by unit , the electromotive force producing that current unity, and the wire conveying that current must nit resistance. For in equation (3) if C, V, H, each be 1, R must be 1 also. The resistance circuit and the electromotive force produced in field by the velocity of one centimetre per second e so small that, although they would be the absolute units of electromotive force and ce, it has been necessary in order to form a ible system to take a much higher velocity. In velocity of 10^9 c. g. s. absolute units has been or this purpose, or the practical unit of resistance n made of such dimensions that it requires a of one thousand million centimetres per to produce unit current through it under similar tances.*

is the unit resistance that has been called *an ohm*, ich is said to be equal to 10^9 centimetre-seconds, n, and very improperly, said to be equal to a of 1,000 million centimetres per second. Re- is a property of inert matter, and velocity is and it is confusing, as well as a misuse of e, to say that resistance is velocity. It is per- rue to say that the formula or dimensional n, which represents resistance in the electro- ic system of units, is the same as that which nts velocity, but this is only true for that system , and it is not true for all other systems. For , in the electrostatic system, a system based on b's electrostatic law, instead of the electro- ic law, resistance and velocity have not the same onal equation.

practically impossible to produce currents in the simple cated above. The Committee of the British Association a method suggested by Sir William Thomson. They used coil of insulated wire rotating around a vertical axis, in the which a small magnet was suspended in the magnetic and which was deflected by the currents generated in the coil through its wire cutting the lines of magnetic force of . Great care, very numerous precautions, many corrections made for the irregularity of the lines of magnetic force of , for imperfect adjustments of the coil and magnet, for of the magnet on the coil, for self-induction of the coil, n of the suspended fibre, for change of temperature, &c. t was an approximation only to the true Ohm, but which has been made the standard of reference in England. Coils ere made to represent this resistance which were distributed

Some writers have carried this concert so far as to express velocities by ohms. Thus the velocity of light has been given as 2·98 ohms.

15. The *Ohm* has been approximately measured by the Committee of the British Association (1861—69), who expended a very great deal of care upon the operation, but in spite of all this care exercised by the most accomplished experimenters of the day, the standard obtained was pronounced, and is known to be, only approximately near the truth. It has been examined by the following physicists with the results given in the table.

1864.	B. A. Unit	1·0000.
1870.	F. Kohlrausch	1·0196.
1873.	Lorenz	·9797.
1876.	Rowland	·9912.
1877.	H. F. Weber	1·002.
1881.	Rayleigh and Schuster ...	·9895.
	Mean	·9932.

Unfortunately the name *Ohm* has been given to the approximate coil and not to the real unit, viz., 10^9 c.g.s. absolute units of resistance. This inaccuracy and this misapplication of the name has left the ground open to the claim of rival units, but only one maintains the field, and that is the Siemens unit, which is the resistance of a column of pure mercury at 0° C., one metre long and of one square millimetre sectional area. There is no reason whatever, of a scientific nature, to justify the retention of this unit except its close approach in magnitude to the true ohm. Had it been a column of mercury 1·0475 meter long it would have been a closer approximation to the true ohm than probably the B.A. unit coil itself. Indeed it is questionable whether a better approach to the ohm could be produced than to adopt Dr. Siemens' method with the corrections necessary to make it the nearest possible approach to this scientific unit. The fundamental units themselves are inexact, and we must be satisfied with mere approximations. As knowledge and skill increase so must greater and greater exactitude be experienced in any new determination of the material standard. A committee of the British Association is now working at the question, and a fresh measurement of the ohm is going to be made on a new method, devised by Professor Carey Foster.

The Committee of the British Association deposited several coils, constructed in different ways and of different metals, in the observatory at Kew.* These were examined in 1867 by Mr. Hockin, and were found to have suffered no change. They were again examined in 1876 by Professor Chrystal, when seven were found constant, but one, that made of Platinum-silver alloy, was found to have deteriorated. They are again about to be examined by the Committee of the British Association. Efforts are also going to be made to obtain for it a legal status in England.

What is wanted is some central establishment for the periodical examination of standard coils and measures, and for the granting of certificates of the correct value of those sent for verification.

(*To be continued.*)

ERRATUM.—November 15th, page 467, last sentence of par. 8—for "7·46 × 10^9 ergs" read "7·46 × 10^6 ergs."

* Two coils were made of platinum and two of mercury, while two were made of each of the following alloys :—
Gold-silver.
Platinum-silver,
Platinum-iridium.
The wires of which the coils were made varied from 1 metre to 2 metres long, and from 0·5 mm. to 0·8 mm. in diameter. They were insulated with silk and saturated with paraffine They are now in the Cavendish Laboratory in Cambridge.

Notes.

ELECTRICAL DIRECTORY.—We have received a specimen page of an *Electrical Directory of England* which will shortly be published by Mr. J. A. Berly, the well-known electrical engineer. The volume will be a complete record of all the industries directly or indirectly connected with electricity and magnetism, and will contain the names and addresses of manufacturers, &c. Every trade which is in any way connected with electricity will be represented. There can be no doubt but that the work will be an extremely useful one, and that no one is more competent than Mr. Berly to make it a success. The general arrangement of the book (as far as can be gathered from the specimen pages) is all that can be desired.

NEW ATLANTIC CABLE.—It is reported that a company is in treaty with Mr. W. T. Henley with reference to the manufacture of a new Atlantic cable.

THE ELECTRIC LIGHT AT BRIGHTON.—The Commissioners for the District of Hove, Brighton, decided at a meeting, held on the 17th ult., to illuminate that portion of the town by the Brush light. It is estimated that the annual cost will be £2,000, as against £1,900 for gas lighting. At the forthcoming Health Congress and Sanitary Exhibition, which will be held in the town in the beginning of December, it has been decided to invite the various patentees to exhibit their electric lighting apparatus, and the gas committee are to recommend the council to expend £300 for the erection of a shed for housing the engines and apparatus.

THE ELECTRIC LIGHT AT THE FIJI ISLANDS.—During the recent visit of the sailor Princes to the Fiji Islands, a display of electric light from the flagship was made. The natives, who for the first time beheld the light, were both astonished and gratified.

THE ELECTRIC LIGHT AND TORPEDOES.—An experiment was made recently with the electric light on board the *Sultan*, at Portsmouth, which will probably effect a revolution in the arrangement and working of the powerful beam which is used in her Majesty's ships for discovering the approach of a torpedo attack at night. As the torpedo detectors are now fitted on board, both the lamps and the men in charge are from their exposed position conspicuously open to attack; the light itself would indicate the vulnerable part; and torpedo craft would no doubt begin the assault by destroying the electrical apparatus by means of their machine guns. As a means of removing this very obvious danger, the dockyard authorities at Portsmouth hit upon the idea of testing the applicability of reflected light for searching purposes at sea. With this object in view an iron tube, 3 ft. 7 in. in diameter, or just capable of containing the ordinary-sized lenses, was carried through the forward hatchway, and extending from the lower deck to about a couple of feet above the top of the funnel when housed for safety. The portion of the tube between the main and the lower deck is made portable, so as to enable the lenses and lamp to be adjusted. The lamp, which is one of Professor de Monnier's, is fixed on a vertical slide within the tube between decks, and is consequently so protected as to be impervious to attack. The carbon points are placed obliquely, and are so arranged that they can be revolved to suit different practical conditions. At the bottom of the tube and below the light, is a plano-concave reflector, while immediately above the light is a dioptric lens; the upper and exposed end of the tube is surmounted by a square iron hood, about four feet in height. This is made to turn in any direction round the tube upon a roller path, and inside of which is a mirror, 3 ft. in breadth and 4 ft. in height, and mounted on a pivot, so that by means of gearing it can be made to project the reflected beam from below at any angle of elevation or depression that may be required. The current is generated by the ordinary apparatus with which ships of war are now provided, and which in this case consists of a D Gramme machine driven by a Brotherhood engine. The system seemed perfectly practicable and under control, but further experiments will be made with the object of testing the merits of different lenses.—*Daily Telegraph*.

REMARKABLE PROPHECY CONCERNING THE ELECTRIC LIGHT.—In a copy of the *Times* for 1878, we have come across an amusing piece of correspondence with reference to the future of the Jablochkoff electric light; the writer of the letter is at the present time not unknown in connection with a system of electric lighting by incandescence; we presume he has seen reason to modify his opinions within the last year or two. The following are extracts from the letter in question:—

"The Jablochkoff candle, as is well known, is worked by alternating currents, or, as it might be said, its action depends on the alternate filling and exhaustion of the electric fluid from the conductors used for conveying the electricity; it is, therefore, evident that even for moderate distances the Jablochkoff system is quite impracticable. Indeed, so convinced am I of the truth of what I say that I venture to assert and without fear of contradiction that one of these candles, giving a light equal to 100 gas jets, when worked in the ordinary way at a few yards distance, would refuse to give any light at all if removed a mile off, however low might be the resistance of the conductors leading to it; the retardation due to the inductive capacity of the conducting cable and the development within it of 'extra currents' so reduces the available electromotive force at the ends of the carbons as to be insufficient for the working of the candle. . . . . Again, another difficulty to be contended against in the use of these intermittent currents through long lines is that of insulation; for, as telegraphists well know, insulation in these circumstances becomes a very difficult matter, and the laws governing it are of a very complex nature. In short, when using alternating currents, the light will be found to decrease with the distance according to some function which very soon becomes for all practicable purposes infinite. I see that the Jablochkoff light is to be used for illuminating the Thames embankment. Here it will be necessary to have about half-a-dozen complete electric works all along the series of lights, one at least for every three candles; but there is no doubt that it will be exceedingly pretty, and I think the Board of Works might as well try the effect of red fire while they are about it—say once a week as a change."

THE ELECTRIC LIGHT IN BRISTOL.—At a recent meeting of the Bristol councilmen a committee was appointed on the motion of Mr. William Smith to report on the practicability or otherwise of utilising the action of the tides and of non-tidal waters, for the purpose of obtaining power by the storage of electricity, to be applied to industrial purposes, for the lighting of the city, or to other uses. Mr. Smith read a letter from Sir Charles Bright, to show that the proposal is a practicable one, and stated that the available tidal power at the mouth of the river is 50 billion foot pounds per annum, or 859,659 horse-power per tide. Five miles higher up the river, at Totterdown, the available energy is 6¼ billion foot pounds per annum, or 279,389 horse-power per tide. Mr. Smith did not suppose they could

utilise even one-hundredth of this power, but what they could utilise would be sufficient to light the city by electricity. They now used about 80 billion cubic feet of gas per annum, the total amount of energy in each cubic foot being 500,000 foot pounds. The city therefore expended 40 billion foot pounds of energy in burning gas, of which, probably, 35 billions or more were wasted in merely warming the air or producing smoke inside the gas lamps. Sir Charles Bright had volunteered to visit the city for the purpose of examining the river. A committee was ultimately appointed to consider the question.

The Electric Light on the Midland Railway.—The Midland Railway Company is about to make an important experiment with the electric light, viz., the lighting of the whole of the Erewash Valley, stations, sidings, and signals. Power is to be obtained from one engine at Chesterfield to light as far as Alfreton, and by another engine at Nottingham to light as far as Pye Bridge. The Erewash Valley has been selected for the experiment on account of there being so many stations, junctions, sidings, and branches, within so short a distance.

The Edison Electric Light.—A correspondent of the *Times* says Mr. Edison is at present supplying 1,100 houses in New York city by meter, at the same rate as that previously charged for gas, and is making a very large profit.

The Electric Light at the Paris Opera.—The experiments at the Paris Opera with the electric light have been successful so far as concerns the incandescent light, which is now regularly used. A final decision on the matter will be come to very shortly.

The Electric Light Companies.—The British Electric Light Company have given notice that during the next Parliamentary session they will apply for an act to authorise and empower the company to break up roads, &c., to enable wires to be laid down to supply electric power for lighting and other purposes. The Electric Light and Power Generator Company apply for similar powers. The Oxford Gas Company, in addition to asking for powers to enable them to make such further extensions to their plant, &c., as are necessary for general purposes, will also ask for powers to enable them to light by the electric light and to apply the use of gas for heating purposes, either directly or through the medium of the electric current.

Action of Cold upon the Voltaic Arc.—By M. D. Tommasi.—When the voltaic arc passes between two rheophores of metal, for instance, of copper, each formed of a tube bent in the shape of a U, traversed by a rapid stream of cold water, and placed horizontally opposite to each other, the following facts are observed:—

1. The illuminating power of the arc is much diminished; it is reduced, so to speak, to a simple luminous point, even on employing a very intense electric current (50 to 75 Bunsen elements, large size).

2. The arc, if it may be so called, is very unstable, so that it is extinguished by the slightest breath of air, or by attempting to light a match at it.

3. If there is placed above the arc, at the distance of 0·004 to 0·005 metre, a piece of paper, a black spot appears after a few moments, which extends, and ultimately penetrates the paper, which, however, is not kindled.

4. The arc consists of a luminous globule, oscillating upwards and downwards between the two rheophores. The form of this globule and its great mobility, recall a drop of liquid in the so-called spheroidal state.

5. On presenting to the voltaic arc the south pole of a magnetic rod, the arc is attracted, and approaches the magnet to such an extent that it is drawn away from the rheophores, and is extinguished. The same fact is observed, though in an inverse direction, on presenting the north pole of the magnet.

6. The quantity of ozone given off seems to be greater than when the arc is not refrigerated. It is to be remarked that notwithstanding the refrigeration of the rheophores, the flame of the arc is greenish, proving that some of the copper is burning. It is further to be asked if the arc would be produced on using for rheophores two platinum tubes, in which alcohol cooled down to — 30° C. (— 22° F.) is made to circulate.—*Comptes Rendus*.

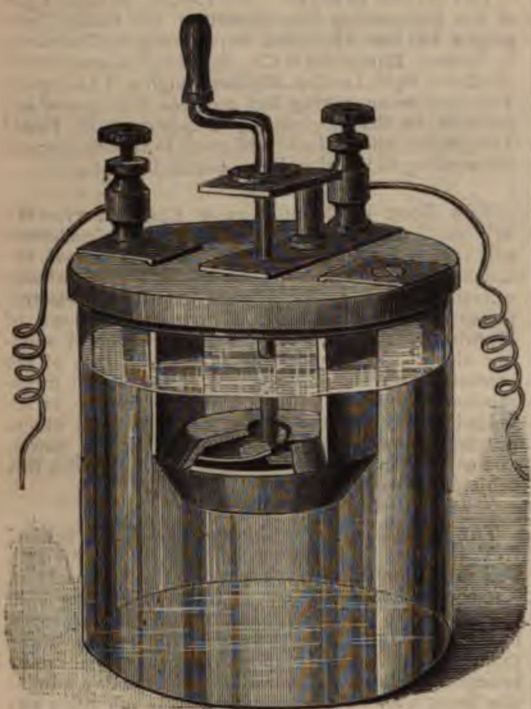
The Brush Electric Light.—Mr. Samuel Vyle, of the Engineering Department of the Postal Telegraphs, has been appointed Superintendent Electrician to Messrs. Hammond & Co., sole concessionnaires of the Brush light, London, Middlesbrough and Liverpool. This gentleman, having had upwards of 21 years' experience in the Engineering Department of Postal Telegraphs, will no doubt add much to the efficiency of the working of the already celebrated Brush lights.

New Book on Motion from Electricity.—Mr. William T. Emmott, of Blackfriars-street, Manchester, will shortly issue a new treatise from the pen of Mr. Urquhart, C.E., of London, dealing in a practical and scientific manner with the great questions of electromotors, and transmission of power by means of electricity. The work will contain examples of existing electro-motive machines in practical use, of the continental electric railways, and of the electric transmission of motive power. The new treatise is intended chiefly for the use of engineers and others practically interested in this form of motive power, and will be the first work of the kind dealing with this subject. It will be profusely illustrated.

The Paris Electrical Exhibition.—The Electrical Exhibition, which finally closed its doors on the 17th ult., is estimated to have produced a net profit of £16,000, and Messrs. Siemens' tramway, running from the building to the Place de la Concorde, has conveyed no fewer than 84,000 passengers during the three months it has been running. An immense crowd besieged the Palais de l'Industrie on the last day, admission being free. In the evening, when the exhibition was illuminated for the last time, there was scarcely standing room either in the main hall or the galleries, most of the visitors being of the artisan class out for their weekly holiday. The usual custom of closing exhibitions by a general letting loose of all the noisy elements contained in the show was observed on this occasion with an almost deafening effect. Shortly before eleven the whistles of all the steam-engines and every electric bell in the building were set going, making such an inharmonious din as was certainly never heard before. Fortunately for the hearing powers of the audience, it only lasted a few minutes, and had the desired effect of clearing the palace of its thousands of visitors. The general utility of the Electrical Exhibition has been recognised by the Paris Chamber of Commerce, which recently passed a vote of thanks to M. Cochéry, Minister of Posts and Telegraphs, and M. Georges Berger, Commissioner-General of the Exhibition. The President of the Republic experienced so much pleasure in hearing the voices of the performers at the Opera and the Français through the telephone that he has caused similar communication to that which existed between the two theatres and the exhibition to be

established with the Palace of the Elysée. The Opera House, the Théâtre Français, and the Odéon Theatre have thus been connected with the Presidential apartments, where a series of "telephonic" soirées commenced on the evening of the 21st ult. To celebrate the success of the Exhibition, the French workmen invited their foreign brethren to a dinner at the Palais Royal, on the 22nd inst. M. Berger presided, and the entertainment was under the patronage of M. Cochéry.

AN IMPROVED BATTERY.—The engraving shows an improved galvanic battery lately patented by Mr. A. Floyd Delafield, of New York city. This battery is provided with means for increasing the strength of the current by producing a more or less rapid circulation



of the solution in contact with the elements by mechanical means, operated by hand or by a motor. This is accomplished practically by fitting the negative element upon a shaft for revolution between the zinc plates, and for increasing the effect the revolving disc is made in spiral form, something like a screw propeller, so that it creates a circulation of solution in the cell, thus continuously depolarising the elements.—*Scientific American.*

ELECTRIC RAILWAYS.—A tram-car on a new electrical system will be soon experimentally run from one end to the other of the Rue de Rennes, Paris. The electric current will be conducted along the inner face of the rails. There will therefore be no wire supported on poles. The scientific world is greatly interested in this experiment. There are electricians who predict the failure of the tram-car in wet weather. The success of the Siemens Electrical Railway has been so great that the Municipal Commission appointed to report on the possible application of electricity will advise the experiment of an elevated railway in some part of Paris. The only objection to the erection of such a line on the Boulevards is its aspect, which it is supposed will not be sufficiently ornamental. A large number of practical suggestions will be made by this Commission.

ELECTRIC BOAT.—A boat destined to be propelled solely by electricity has just been completed, according to *La Lumière Electrique.* The owner, M. Tellier, intends to launch it at Boulogne and to cross in it to Folkestone, in company with a friend. The boat is decked, and is about 18 ft. long by about $4\frac{1}{2}$ ft. wide.

ON THE ABSOLUTE MEASUREMENT OF CURRENTS BY ELECTROLYSIS.—By M. Mascart.—The author has redetermined the electro-chemical equivalent of water. He introduces into a vacuum a galvanometer which contains a solution of phosphoric acid between thin platinum wires as electrodes. The gas given off is collected by a mercurial pump, and its volume is measured when dry. No ozone is formed and no gas is condensed in the electrodes or dissolved in the liquid. It is preferable to prepare a precipitate of silver from the nitrate, using at the same time silver as the positive electrode, which dissolves. The difference between the precipitated and the dissolved silver amounts to $\frac{1}{1000}$. The measurement of the current electro-magnetically, was made by means of an electro-dynamical balance, to one of the scale-pans of which was suspended a long cylindrical spiral in such a manner that its lower surface lay in the plane of symmetry of two large, horizontal flat spirals. The currents enter the movable spiral by two thin, spirally-coiled platinum wires. As the intensity of the current is continually changing, the times are noted in which the attraction of the spirals varies by 10 grms. Finally the equilibrium of the spirals without the current is determined both at the beginning and at the end of the experiments. The quantity of silver, p, proportional to the square root of the attraction, P, in the balance, varied from 700 to 900 mgrms., during an experiment of from 25 to 45 minutes; the attraction in the balance was from 1,500 to 4,000 mgrms. In five experiments the ratio $\sqrt{P}\, p = 132{\cdot}85$ ($132{\cdot}79$—$132{\cdot}94$). If the coils of the flat spirals are considered as of equal radius and as lying in the same plane, and the section of the movable spirals as very small and their length very great, the attraction is a simple function of the length of the wires, the number of coils, the length of the cylindrical spirals, and the effect upon the balance. If the equivalent of silver is taken at $107{\cdot}93$, the electro-chemical equivalent of water $= 0{\cdot}009373$ m.g. Using the absolute units of the British Association, a current of the intensity of 1 weber will decompose $0{\cdot}09373$ m.g. water, or $0{\cdot}010415$ part of the equivalent of a body in milligrams. A current, which in a second decomposes 1 equivalent of a body in milligrams, would be $= 96{\cdot}01$ weber.—*Wiedmann's Beiblätter.*

THE DEPOLARISING PROPERTIES OF SALINE SOLUTIONS.—By D. Macaluso.—Lippmann found that a negative electrode consisting of a metal, A, is polarised in solutions of various salts, single or mixed, but not when the solution contains traces of a salt of A.

On the other hand Macaluso found that the polarisation of A in the solution of a salt of a metal, B, is always modified by the addition of a salt of a third metal, C, when C (which, according to Macaluso, occasions the polarisation) is substituted for B in the solution and the more quickly the more energetically this substitution takes place. As the metal, A, does this most powerfully the addition of the salts of A to those of B decreases the polarisation most.

Some objections made by Lippmann (*Journal de Physique*, 10, p. 167) are taken into consideration. Thus Lippmann finds that a cathode of copper in a solution free from copper assumes a permanent polarisation, whilst Macaluso observed that it was quickly depolarised. According to Lippmann this discrepancy is due to the circumstance that Macaluso plunged the copper plate into pure, dilute sulphuric acid and afterwards washed it with distilled water and dried it, whereby a thin layer of a copper salt is supposed to have been formed.

Macaluso shows that this is impossible, as the solution even after prolonged use contained not a trace of copper.

Macaluso finds also that the polarisation of a cathode of copper quickly vanishes in a solution of sulphate of zinc quite free from copper after the passage of feeble currents, but more slowly in case of stronger currents.

When by repeated action of the current, after the polarisation has each time disappeared, it becomes more permanent. This phenomenon is not due to the formation of a copper salt, since on agitating the electrode the polarisation decreases and becomes less permanent, whilst any layer of a salt of copper which had been formed would be removed.

According to Macaluso, cobalt is depolarised with difficulty in its own salts, which Lippmann ascribes to rapid superficial modifications of the electrodes. Macaluso has not observed such changes, but has obtained very constant results after they have been polished.

The view of Lippmann, that the electric work expended in exciting polarisation is accumulated not in the form of chemical energy but in that of electric energy, as in an accumulator, is not shared by other physicists.—*Wiedemann's Beiblätter.*

THE PILSEN LAMP.—The *Times* correspondent, in speaking of the Paris Electrical Exhibition, thus alludes to this lamp in the issue of November the 17th:—"In my opinion, one of the best lamps in the building for working with a good many on one circuit is the Pilsen lamp. This is shown in the Austrian section, and also by Mr. Fyfe in the British. In both cases it is fed by a Shuckert machine, which is really a Gramme machine, with a flat ring and with field magnets at the sides, as in a Brush machine. I have watched this lamp carefully since the beginning of the exhibition, and have always found its action perfect. At the same time, while being very simple, it is furnished with every device against derangement which can be desired." At the Smoke Abatement Exhibition at South Kensington six of these lamps will be shown by Messrs. Rowatt and Fyfe. We understand that several of these lamps have been employed, with most satisfactory results, for the last six months at the Farningham Paper Factory, and installations have been made both at Glasgow and Dublin. At the forthcoming exhibition at the Crystal Palace ten of these lamps will be shown in action.

THE JOEL LAMP.—This lamp will also be exhibited by Messrs. Rowatt and Fyfe, at the Smoke Abatement Exhibition, where 10 factory lamps will be worked from a Siemens' D^2 machine. At the Crystal Palace 36 of these lamps will be exhibited, and there are now at the Prudential Assurance Company's offices, 18 of these lamps, which have been working most satisfactorily for the past two months, giving the necessary light for 100 clerks at their duties. These replace 90 gas jets, with greatly increased efficiency, and having the great advantage of leaving the atmosphere pure and cool.

THE JABLOCHKOFF LIGHT.—The candles for this system will henceforth be sold at 2d. each.

TENDERS FOR ELECTRIC LIGHT.—The gas committee of the Sevenoaks Local Board are prepared to receive tenders for lighting their streets by electric light. Particulars can be obtained of the Clerk of the Local Board, Sevenoaks, Kent. Tenders to be sent in on or before the 10th December, 1881.

THE BRITISH ELECTRIC LIGHT COMPANY.—It is reported that Professor Forbes is to be Managing Director of this Company, and it is also said that Mr. Ward, the engineer, and Mr. Wills, the secretary, have resigned.

ELECTRIC LIGHTING.—Mr. Finglands' hosiery factory, Hawich, has been successfully lighted with Swan's lamps. Messrs. Roberts & Co., Selkirk, have entered into a contract with an Edinburgh firm for an immediate introduction of the electric light into the Forest and Philiphaugh Mills. Should the experiment prove satisfactory, it is anticipated that the other Tweed mills will follow suit.

THE EDINBURGH TOWN COUNCIL have decided that the Brush Electric Light is not a suitable illuminant for the streets of their city. This decision has been come to, it is said, in consequence of the numerous complaints made regarding the unsatisfactory nature of the light. It has been in use for three months and has cost the ratepayers £838. The Brush Electric Company have offered to supply the light at 2d. per hour per lamp, and the Gas Light Company an improved light for about half the sum. We think the Edinburgh people must be hypercritical, or the installation not so efficiently managed as those by the same company in London.

ELECTRIC LIGHT AND THE FINE ARTS.—The application of the Maxim incandescent electric light to the illumination of the Glasgow Fine Arts galleries has during the past fortnight been practically demonstrated. The opinion expressed is that this light is better for the examination of pictures than the "*arc*" light. We believe that these are the first picture galleries in the kingdom *entirely* lighted by electricity.

THE TELEPHONE ON BOARD SHIP.—A telephonic system worked by Hunning's micro-telephone transmitters, and Harrison, Cox-Walker, & Co.'s (Darlington) receivers, has been introduced on board the screw-steamer *Gloucester City*, a vessel of splendid fit-out, 2,150 tons gross register, which was launched a few weeks ago by Messrs. Richardson, Duck, & Co., of Stockton-on-Tees, and is now taking in her engines and being made ready for sea at Hartlepool. The wires extend from the captain's berth to the chart-house; and there is no difficulty in gaining the ear of the officer on watch posted on the bridge; and the captain, if in the chart-house, can by the same means communicate with the ship's company. The cost, complete, is £17 10s. The same appliances were lately provided on board the *Brooklyn City*.

THE COST OF TELEPHONIC TELEGRAPHY.—According to the figures supplied by Mr. J. W. Batten, a week or two ago, the United Telephone Company passed along its wires 19,522 messages a day for 1,218 subscribers, at a total cost to them of £81, or as nearly as possible one penny per message.

THE UNITED TELEPHONE COMPANY (LIMITED) *v.* ALEXANDER MACLEAN, EDINBURGH.—In the Bill Chamber of Court of Session a process to obtain interdict against alleged infringement of patent for Edison's transmitter and Graham Bell's telephone receiver was heard on November 17 before Lord MacLaren. It was complained that the respondent (Alexander MacLean)

who is a telephone contractor in Edinburgh, had infringed these patents by putting up at least nine transmitters and receivers. In the course of discussion it was submitted for respondent that Edison's patent is bad, has been anticipated, is of no public utility, and has not been infringed by respondent. It was admitted that he had infringed Bell's patent, but had discontinued the infringement and undertook not to use the patent in future. In respect of this admission it was submitted that the complainers were entitled so far as regards Bell's patent to interdict and damages.

The Lord Ordinary granted *interim* interdict and passed the note for the Lord Ordinary of the Court of Session to try the other question raised.

A TELEPHONE EXCHANGE has been opened by the National Telephone Company Limited, at Aberdeen. A considerable number of connections have already been made; the captain, pilot, and dockmaster's offices being on probation for a period of twelve months.

THE TELEPHONE IN LANCASHIRE.—By direction of the Postmaster-General, the local postal and telegraph authorities have just completed a double line of wire for telephone purposes between Manchester and Liverpool.

UNDERGROUND TELEGRAPHY IN PHILADELPHIA.—A test of the working of the new line on Market Street of the National Underground Electric Company was made recently at Philadelphia with three telegraphic instruments, two telephones, and an electric lamp. Solenoid wires, consisting of a single insulated wire wound about a similar straight wire, connected them. It is reported by the Philadelphia journals that the experiment proved successful.

UNDERGROUND TELEGRAPHY IN ENGLAND.—It is reported that the engineers of the postal department advise the Postmaster-General that the cost of putting the principal lines underground will be 1¾ millions sterling.

UNDERGROUND TELEGRAPHY IN FRANCE.—Since the recent decision to employ underground wires extensively in France has been announced, the price of gutta-percha insulated wire in that country has risen 35 per cent.

THE "FARADAY."—The s.s. *Faraday* has returned to London completely disabled, one of her screw shafts having broken. To effect the repairs it will be necessary to unship nearly the whole of the cable; a considerable period must consequently elapse before the vessel can again be ready for sea. As a large holder of Anglo-American stock, Mr. Jay Gould may possibly not look upon the accident in the light of a great disaster.

INTERNATIONAL EXHIBITION IN NEW ZEALAND.—An International Exhibition will be opened at Christchurch on March 18 next. A special section will be devoted to the exhibits from Great Britain. Gold, silver, and bronze medals will be awarded. All particulars may be obtained at the International Exhibition Offices (Messrs. J. M. Johnson and Sons, Limited), 1, Castle Street, Holborn.

TELEGRAPHIC CLERKSHIPS IN THE POSTAL TELEGRAPH DEPARTMENT.—An open competition for admission to the Post Office (male) School of Telegraphy (age 14—18) will be held in London on December 19. For particulars and the necessary form of application apply at once to the Secretary, Civil Service Commission, London, S.W.

ROYAL INDIAN ENGINEERING COLLEGE, COOPER'S HILL, STAINES.—This college has been recently placed on a new basis, and the advantages afforded by it as a training institution for those who purpose adopting the civil engineering profession in India or elsewhere are now offered to all persons desirous of following the course of study pursued there. A number of students, not exceeding fifty, will be admitted to the college in September, 1882. Candidates for admission must, on July 1, 1882, be over seventeen and under twenty-one years of age, and must give satisfactory proof of their having received a fair general education. The Secretary of State for India will offer sixteen appointments in the Indian Public Works Department for competition among the students entering the college in September, 1882, at the termination of their prescribed three years' college course, that is, in the summer of 1885. The Secretary of State for India will further offer two appointments in the Indian Telegraph department among the same students after two years' course of study, that is, in the summer of 1884. In the event of there being more candidates for admission than the college can receive, the preference will be given to qualified candidates according to dates of application for admission. For all further particulars apply, by letter only, to the Secretary, Public Works Department, India Office, S.W., or to the President, Royal Indian Engineering College, Cooper's Hill, Staines.

THE SECRECY OF TELEGRAMS.—At Manchester on November 18, a man named Watson was committed to the assizes, charged with inducing a telegraph clerk to reveal to him the contents of sporting telegrams on the 10th inst. The prisoner was seen to pick up a piece of paper, thrown to him out of a window in the telegraph office, and on being examined, it was found to contain information respecting that day's racing at Aintree.

BRITISH ASSOCIATION MEETING AT SOUTHAMPTON.—A meeting of the General Committee for the reception in Southampton, in August next, of the British Association for the Advancement of Science, has been held in that town, under the presidency of the Mayor. An influential local executive committee was appointed, which included the head of the Ordnance Survey Department, and some of the chief medical authorities at Netley Hospital. It was resolved to invite the chief residents of the country on the occasion, and to ask Prince Leopold to become vice-president.

TRANSMISSION OF MONEY BY TELEGRAPH.—The Postmaster-General is of opinion that its introduction is not called for.

THE CENTRAL AND SOUTH AMERICAN CABLES.—The India-Rubber and Gutta-Percha Telegraph Works Company's s.s. *Dacia* left Greenhithe on the morning of Saturday the 19th ult. having on board over 800 miles of cable for the Central and South American Telegraph Company. Stress of weather, however, compelled her to put into Plymouth and she left England finally on the Wednesday after, at daylight. It will be remembered that the s.s. *International* left on the 9th November with a portion of the cable for the above-named company. The loading of the *Dacia* was very remarkable for the speed at which the cable was coiled on board. It seems that the vessel was handed over by the Post-office authorities (who had chartered her for the recent repairs to their cables) on Monday the 7th of November. She was then docked, cleaned, painted, and moored off Silvertown on Thursday morning the 10th, leaving that place on the Tuesday evening following, having shipped the cable at the rate of

165 miles per day. This includes some slight waste of time, owing to a strike amongst the cable coilers. The following are the stations and lengths of cable of this company:—From Vera Cruz to Goatzacoalcos, 90 miles; Goatzacoalcos is connected with Tehuantepec or Salina Cruz by a land line about 220 miles in length; the cable then continues from Salina Cruz to San José de Guatemala, 320 miles; from San José to Salinas Bay, distance 390 miles; from Salinas Bay to Punta Mala at the mouth of Panama Bay, 560 miles; from Punta Mala to Panama Town, 95 miles; from Puntá Mala again to Buenaventura, 320 miles; Buenaventura to St. Elena, 500 miles; from St. Elena a branch land line of a 110 miles is run to Guayaquil; St. Elena is then connected by cable to Payta (Peru), 230 miles; the last section of this company's cable being from Payta to Chorillos, 580 miles. At Chorillos (the landing place for Lima) the line joins that already existing and belonging to the West Coast of America Telegraph Company.

The s.s. *Retriever*, the repairing vessel of this latter company, has been chartered to accompany the present expedition, and to thoroughly survey the route over which it is proposed to lay the cables. The India-Rubber and Gutta-Percha Company have sent out an experienced chemist to analyse the nature of the specimens taken from the bottom during sounding operations. We believe this is the first occasion on which such kind of investigations has been undertaken by a cable company, and the management at Silvertown is deserving of all credit for its meritorious endeavours to increase our knowledge of that part of the globe, of which so little is known, viz.—the ocean bed. These operations will be carried out under the direction of Mr. E. W. Parsone, the engineer and manager of the West Coast Company. The *Retriever* is very completely equipped for the purpose of these researches, having on board, besides the usual cable repairing gear, a steam sounding machine (a modification of Sir W. Thomson's wire sounding apparatus). A chemical laboratory is also fitted up on board. The intention is to take some 900 or 1,000 soundings at an average distance apart of four miles; this, of course, does not include a large number which will be taken at closer intervals near the landing places. Up to the present all that has been considered necessary in this direction was to take soundings at intervals of about 30 or 40 miles, and in fact, when the Atlantic cables previous to 1875 were laid, the soundings numbered only 57, over a distance of 1,700 miles. It may here be added that the India-Rubber and Gutta-Percha Company were the first to use Thomson's wire-sounding machine extensively, the first experiment dating from November, 1872; and in 1875, on the same coast, whilst submerging the West Coast of America Company's cables, 460 soundings were taken over a distance of nearly 1,700 miles, exclusive of soundings for landing places.

It will be seen from the foregoing statements with what very great care the operations of this company are carried out in every detail, and we venture to say that the benefits to be derived from such a series of investigations as those mentioned above must be immense, not only to the company conducting them, but also to all who are connected directly or indirectly with shipping and commercial interests in that quarter of the world.

Out of the 3,000 and odd miles of cable ordered by the Central and South American Company, 1,750 miles are already manufactured, and the greatest turn out in one week on this order, not including any of the usual outside work, was 174 miles. In our next issue we shall probably give an account of the various types of cable to be used on this expedition.

THE WEST INDIA AND PANAMA CABLES.—At the Silvertown Works, 300 miles of cable are now being manufactured for this company, 250 miles being deep sea, and 50 miles Cuba type; the engineers are Sir Samuel Canning and Robert Sabine, Esq., C.E.

ACTION AGAINST A CABLE COMPANY.—With reference to the case of Harold *v.* the India-Rubber and Gutta-Percha Company, which we referred to in our last issue, it was remarked that during the proceedings the case was closely watched on behalf of the Telegraph Construction and Maintenance Company, who, we are informed, are interested in the plaintiff's concession to the amount of some £1,500. A similar injunction against the Central and South American Telegraph Company was prayed for in the courts in Philadelphia, but, like the prayer in the English courts, it failed to bring any result.

STORMS.—The past fortnight has been prolific of violent storms of wind and hail, thunder and lightning. The interruption to telegraphic communication within the United Kingdom has again been great, more especially on the west coast of Scotland, where in some places as many as 30 poles were blown down, and the wire swept into the sea. On the evening of the 16th ult. a brilliant display of aurora borealis was witnessed at Dundee, shortly afterwards followed by a violent thunderstorm, the lightning flashes being very vivid and the thunder peals loud and prolonged. On the 22nd November another thunderstorm passed over Scotland, doing considerable damage to property. At Dunphail station on the Highland railway, the telegraph instrument was thrown out of its place; at Greenock, Hillside Cottage was struck, a pilaster which projected about two inches from the face of the wall being torn down and broken in pieces, the stone step broken, and the cupola of the roof carried away. At Tighubruich the flag turret of Glen Caladh House was damaged; great masses of the heavy stone parapet being thrown down, the wood and iron work at its base torn away, and the cast iron water main, which is buried about five feet underground, destroyed. One of the domestics sustained a shock, but quickly recovered.

Correspondence.

TELEGRAPHIC COMMUNICATION WITH LIGHTSHIPS.

To the Editor of THE TELEGRAPHIC JOURNAL.

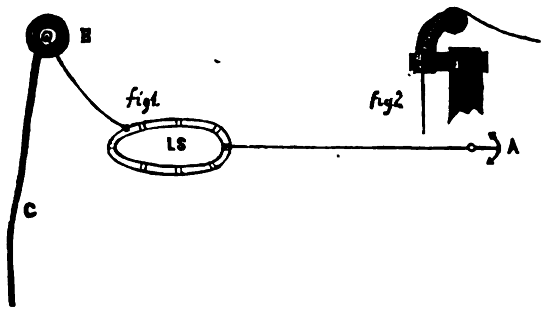
SIR,—I inclose a sketch of an arrangement intended to obviate the difficulty which is at present experienced of maintaining telegraphic communication with lightships, owing to the swinging around the moorings caused by the tide and the occasional lengthening of the mooring cable.

It is proposed to attach the telegraph cable to a buoy held in position by a heavy weight and placed outside the circle in which the ship moves around its moorings, and to complete the connection with the ship by means of a small but strong insulated wire. A sufficient length of this wire is wound upon a drum which has for its axis a rail which completely surrounds the ship. The length of wire may be varied at will and the direction of the cable buoy followed by sliding the drum around the rail. The supports of the latter are in pairs and hinged so that they can be unpinned and turned down one at a time to allow the drum to pass.

In the event of the connection between the cable

buoy and the lightship being broken a new wire can be connected in suitable weather.

Where the lightship has but one mast an overhead wire may be employed, passing up a channel in the mast and over a swivel pulley at the top to a short pole



on the cable buoy. The length of wire being varied from a drum upon the deck.

In the sketch, L S, fig. 1, is the lightship; C, the telegraph cable; B, the cable buoy; and A, the lightship anchor.

Fig. 2 shows the pulley for the overhead wire.

Yours truly,
F. H.

THE CRYSTAL PALACE ELECTRICAL EXHIBITION.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—The ending of your leader of the 15th leads me to hope that the public may rely on your impartiality in the coming Electric Exhibition—that we shall not find you partial to names and systems, and that, as formerly, you denounced re-inventions, we shall still find you only giving credit to whom it is due. "Electrophiel's" letters in the *Times* lately met with no answer from the "telephone corners," and except your mention of their late purchase, the public hear little of them. Should they get up a Telephone Exchange at the Crystal Palace, and go on claiming everything almost, as heretofore, they may persuade the public that there is but one telephone, and that their own property. Those who were fortunate enough to get the business of the Opera and the Exchange at the Paris Exhibition, got well written up, and have doubtless reaped much profit, and their claim for originality in their instruments allowed by those not conversant with the matter. Such like things I trust you will keep us clear from, and give every one his due.

I am,
Your obedient servant,
X.

23rd Nov., 1881.

THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.

ELECTRICIAN, N. B.—Associates must be of more than 21 years of age, and must be either electrical or telegraph engineers by profession, or must be engaged on responsible electrical or telegraph work; annual subscription, £1 1s. Students must be over 18 and under 21 years of age, and must either be serving a pupilage to an electrical or telegraph engineer, or must be studying natural science; he must be recommended by a member; annual subscription, 10s. 6d. Forms of application for admission to the Society may be obtained from the Secretary, at 8, Broad Sanctuary.

Proceedings of Societies.

THE PHYSICAL SOCIETY—NOV. 12TH.

THE first meeting of the Physical Society for the winter season was held on Saturday, November 12th, Professor FULLER, vice-president, in the chair.

Mr. W. D. Niven was elected a member.

Mr. LEWIS WRIGHT then read a paper "On some Spirals observed in Crystals, illustrating the relation of their Optic Axes." After remarking that the relation of the axes in uni-axial and bi-axial crystals had always been an interesting subject, he observed that if we took any uni-axial and a single axis of any bi-axial which had little or no axial dispersion, and polarised and analysed each circularly, we ultimately got similar phenomena. This is illustrated by calcite and a single axis of sugar, each giving when thus treated, unbroken circular rings. From this it might be hastily inferred that a single axis of a bi-axial resembled in character the axis of a uni-axial. But this was not the view of those who framed the theory of double refraction in crystals. Fresnel finally framed the conception of three elasticities in three rectangular directions. If all were equal there was no double refraction; if only two were equal there was a single optic axis in the direction of the third; and if all were unequal there were two optic axes. According to this theory, the axis of the calcite did *not* resemble in character a single axis of the sugar or other bi-axial, but was a limiting case in which *both* such axes coincided. This was illustrated by the beautiful experiment of Professor Mitscherlich, applying heat to a crystal of selenite, and thereby altering the respective elasticities. The two axes gradually approached until they coincided, and the crystal became uni-axial, after which, on heating the crystal still more the axes re-opened in a direction at right angles to the former, thus proving Fresnel's theory. Sir George Airy had illustrated the point—that the axis of a uni-axial did retain, or still embraced within itself in some visible form, characteristics of the two axes thus brought into coincidence. This was done by his discovery of the double spiral in quartz. Uni-axial calcite showed a double spiral, and bi-axials gave a single spiral. Mr. Wright repeated Professor Mitscherlich's experiment with this additional method of analysis; the spirals being first shown perpendicularly arranged above each other. Gradually they approached, until they resembled those of the calcite, and finally opened out again horizontally. All through there was a double spiral, and a single one could only be got by separating a single axis. The fluid would represent the axial properties of the quartz and the crystal the other properties, and the two ought to give similar spirals. In fact the fluid should replace the quartz successfully in all these experiments. By means of a column of oil of lemons, 200 millimetres in length, and crystals of calcite, sugar, topaz, and nitre, Mr. Wright showed this to be the case. Finally, he demonstrated that the same phenomena held good through all the ordinary analogies with, or artificial substitutes for, natural crystals; the figures being produced with a circular chilled glass in parallel light, and also with an artificial uni-axial crystal, made of crossed mica films, after Norremberg, and an artificial quartz made of superimposed mica films, after Reusch, in convergent light. All the figures were projected by the electric camera to a size 8 ft. in diameter. All Mr. Wright's experiments went to illustrate the truth of Fresnel's theory.

Mr. C. V. BOYS then read a paper "On the Prevention

of the Bursting of Water Pipes." Mr. Powell had proposed the use of pipes of elliptical or other round section, and Mr. Mangnall, of Manchester, had independently suggested the same idea. Such a pipe would become rounder in section when the water froze and expanded. A round pipe tends to become thinner at its weak parts, on expanding under the pressure. With an elliptical pipe the force required to alter the shape of its section is greater as the section is more circular, therefore the effect produced by a change of shape at any place makes that place stronger. A round pipe is in a state of unstable, and an elliptical pipe in a state of stable equilibrium, and changes its form uniformly from end to end. Hence, if a portion only of such a pipe is exposed to the cold, the whole is effective, and it will require a proportionally greater number of frosts to make the pipe round. Inspection would show if the pipes were becoming round, and then they could be squeezed back to their original shape. Mr. Boys had demonstrated these inferences by experiment with Mr. Powell. Messrs. Powell, Rigby & Co., of Piccadilly, made these pipes.

Mr. I. MACFARLANE GRAY drew attention to some apparent discrepancies in the constants employed by Regnault in his work on the "Physical properties of steam."

THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.

AT an ordinary general meeting of this Society, held November 24th, Professor CAREY FOSTER, president, in the chair, a paper on "THE PARIS ELECTRICAL EXHIBITION" was read by Sir CHARLES BRIGHT and Professor D. E. HUGHES, F.R.S., two of the commissioners appointed by Government to represent British interests at the exhibition. A narration was given of the work done by the Society in the first instance, by which the British section of exhibitors were brought together, and the proportionate amount of awards of diplomas and medals given to them was stated as being highly creditable to the country. A special diploma, the only one of its kind accorded to any society in Great Britain, had been granted by the juries to the Society of Telegraph Engineers and of Electricians for their labours in promoting the success of the exhibition.

The most salient features of the exhibition were then described, comprising the generation of electricity, its transmission, and its various applications. Among the latter may be specially enumerated telegraphy and submarine cables, telephony, microphones, lighting, galvanoplastics, fire alarms, clock regulating and meteorological registers, observatory work, and military and naval operations in torpedoes, lighting and signalling, together with ballistic experiments. The transmission of force to a distance and its storage, with many other practical applications to the arts and industrial purposes, with the instructive exhibits of different countries under these heads, were described in the same systematic manner as a visitor might have seen them under the guidance of an expert in electrical science.

In the discussion which followed the reading of the paper—

Professor ABEL commented on the display there of the applications of electricity to military purposes by foreign countries, and said that the English *matériel* in this department would have stood pre-eminent if the Government had permitted its exhibition.

Major FLOOD PAGE stated that with only a few exceptions the whole of the exhibits mentioned in the report would be displayed at the forthcoming Crystal Palace Exhibition, and that the arrangement of the electric lights would be such as to show each system to an equal advantage.

Mr. STROH, Mr. E. GRAVES, Mr. FLETCHER MOULTON, and Mr. FOSTER also took part in the discussion.

A special vote of thanks to the authors was carried, not merely for their paper, but for the eminent services which they had as commissioners rendered to the English section. The services of the honorary foreign secretary, M. Aylmer, were also highly eulogised, and some of the exhibitors present expressed a wish that the services should be acknowledged in a more substantial form. The meeting then adjourned.

THE SOCIETY OF ARTS.

AT an ordinary general meeting of this society held Nov. 23rd, a paper was read by PROFESSOR SILVANUS THOMPSON on "THE STORAGE OF ELECTRICITY." Professor Thompson commenced his discourse by pointing out that the reversibility in action of the voltaic cell is the counterpart and complement of the reversability of the Gramme machine; and while the one has solved the problem of the electric transmission of power, the other has solved the problem of the electric storage of energy. The electric storage of energy must not be mistaken for the storage of electricity itself. A century ago, it was thought that the Leyden jar provided a means of bottling-up electricity itself. In one sense this may be true, though the fact remains, that the more carefully we hunt for the charge of electricity condensed in the jar, the more difficult does it become to realise that there is anything there; and it is doubly difficult to find, in the electric accumulator or storage cell, anything which can be called stored electricity. In electric accumulators, such as those of Planté and of Faure, electric currents are made to do a certain kind of work, which store of work can again yield us currents of electricity. But as a matter of fact, the particular kind of work done is quite as much chemical as electrical.

The reversibility of the Gramme machine affords a means of electric, or rather of electro-mechanical storage. Suppose we want to store electric currents. Set them to drive a Gramme machine, and let the Gramme machine, by means of a pulley, gradually wind up a very heavy weight. If, subsequently, we let the weight descend, it will drive the Gramme machine, and will generate currents as it runs down.

In overcoming polarisation force we do the work of storage. We do electro-chemical work by overcoming electro-chemical forces, just as we do mechanical work by overcoming mechanical forces.

LAWS OF POLARISATION.

To tear away an atom of any element from its compound with an atom of another element, requires the use of a definite amount of electricity, and necessitates further that this electricity should be urged forward with at least a certain minimum electromotive force. Take for example the case of the decomposition of water by the electric current. To tear away a single gramme of hydrogen from the oxygen with which it is combined requires no less than 95·050 webers ("coulombs") to flow through. But these liberated and separated gases are in one sense a store of energy, and would, if allowed to combine together (by burning), produce heat. Their "affinity" for one another is very

great, and the electric current has to do a considerable amount of work in tearing these two kinds of atoms away from one another. To see what this work amounts to, let us inquire how many units of heat they would evolve in burning. Careful measurements by Favre, Andrews, and Julius Thomsen, show that 34,000 calories of heat would result. Now the work done to separate the gases is of course equal to the work they would do by rushing together. The affinity of the gases manifests itself as a reaction against the electromotive force of the current employed to separate them. This reaction is itself a counter-electromotive force. When we overcome an opposing electromotive force by pushing a certain quantity of electricity from one point to another against its reaction, we do work just as truly as when we overcome an opposing mechanical force by pushing a certain lump of matter from one point to another against its resistance. In the particular case of the decomposition of water, the opposing electromotive force of polarisation has a magnitude when expressed in the proper units of 1·493 volts. It is possible, when we know how much heat would be evolved by the combination of an equivalent of any substance with oxygen, to calculate the value of the electromotive force that would have to be applied to tear away that substance from its combination with oxygen. Or, again, suppose we know that of two elements one will, when combining with its equivalent of oxygen, give out more heat than another, then we know that it has a greater affinity for oxygen, and, from the difference between their "heats of combination," we can calculate the surplus of electromotive force that we should have to apply to tear away one of these two from oxygen, and to put the other in its place.

In the accompanying table are given, firstly, the equivalent heat values of the various metals when

TABLE OF ELECTROMOTIVE FORCE AS CALCULATED FROM THE HEAT OF OXIDATION OF THE CHEMICAL EQUIVALENT (H = 1 GRAMME), AND AS OBSERVED BY DIRECT EXPERIMENT.

Name of Substance.	Heat Value.	E. M. F.	Electromotive Force observed in Dilute Sulphuric Acid.				
	Calories.	Volts.	With Oxygen.	With Platinum.	With Ozone.	With Peroxide of Lead.	With Zinc.
Potassium	69,800	3·04	...	3·17 (Bf.) 2·484 (Wh.)	...	3·528 (Wh.)	— 1·144 (Wh.)
Sodium	67,800	2·95	...	...	...	...	...
Zinc	42,700	1·862	1·873	1·546 (Po.) 1·439 (Wh.) 1·67 (Bz.) 0·637 (R.)	...	2·448 (Wh.) 2·98 (J.)	O
Iron	34,120	1·570	...	...	...	...	[0·600 (A. & P.)]
Hydrogen	34,100	1·493	? 1·64 (Ta.)	0·86 (R.) 0·877 (Bz.)	1·9 (R.) 2·1 (Wh. Po. Sv.) 2·3 (Bf. Ta.) 2·265 (Ba. Bz.)	? 2·78 (Pl.)	...
Lead	25,100	1·133	...	...	...	2·38 (Pl.)	0·21 (A. & P.) 0·55 (D. L. R.)
Copper	18,760	0·818	0·74 (R.)	0·550 (R.)	...	...	0·953 (Po.) 1·079 (L. C.) 0·978 (L. C.) [0·75 (A. & P.)]
Silver	? 9,000	...	...	...	...	...	
Platinum	7,500	0·327	...	O	1·21 (R.) 1·04 (R.)	0·6 (R.) 0·75 (R.) 0·90 (Wh.)	1·546 (Po.) [1·439 (Wh.)] 1·67 (Bz.) [0·981 (A. & P.)]
Carbon	? 2,000	...	...	...	1·435 (L. Swj.) 1·18 (R.)	...	[1·096 (A. & P.)]
Oxygen	O	O	O	...	...	...	...
Nitric Peroxide	— 6,000	—0·29	...	...	...	...	1·97 (Bf.) 1·95 (L. C.) 1·90 (Sb.)
Chromic Peroxide	— 7,195	—0·31	...	...	...	...	2·028 (Sb.)
Manganese Peroxide	...	...	...	—0·54 (Wh.) —0·101 (R.) —0·128 (R.) —0·404	...	0·504 (Wh.) 0.420 (J.)	1·944 (Wh.) 2·55 (J.)
Lead Peroxide	...	...	...	—0·6 (R.) —0·75 (R.) —0·90 (Wh.)	...	O	2·448 (Wh.) 2·98 (J.) 2·1 (D'A.)
Silver Peroxide	...	...	...	—0·7 (R.) —0·86 (R.)	...	...	...
Hydrogen Peroxide	—10,800	—0·47	...	...	...	...	...
Ozone	—14,800	—0·645	...	—1·04 (R.) —1·21 (R.)	O	...	...

D'A., D'Arsonval; Ba., Bartoli; Bf., Buff; Bz., Beetz; L. C., Latimer Clark; D. L. R., De la Rue; J., Joule; L., Lenz; Pl., Planté; Po., Poggendorff; R., Raoult; Sb., Sabine; Sv., Svanberg; Swj., Saweljew; Ta., Tait; Wh., Wheatstone; A. & P., Ayrton and Perry (whose observations, being made with an electrometer for contact in air, are placed in square brackets, as not being, like the rest, observations on the electromotive force in sulphuric acid.

oxydised and dissolved in sulphuric acid. In the second column are given the electromotive forces that would be needful to tear away these elements from oxygen, or with which they tend to unite with oxygen—the value, in fact, of the electromotive force which measures electrically the chemical affinity of each of these elements for oxygen.

The order in which these metals are arranged is, in fact, nothing else than the order of oxidisability of the metals (in the presence of dilute sulphuric acid); for that metal tends most to oxidise which can, by oxidising, give out the most energy.

REACTION OF PEROXIDES.

In the preceding discussion, oxygen has been taken as the standard electro-negative substance. But in point of fact there are substances more highly electro-negative; that is to say, substances which when made to combine with a metal such as zinc would give out together a larger amount of heat than zinc does with oxygen. Chief amongst those substances are chlorine and the haloids, the peroxides of the metals manganese, lead and silver, such peroxidised bodies as chromic, perchloric, and permanganic acids, the peroxide of hydrogen, and ozone. If, for example, zinc be caused to combine with an equivalent of peroxide of lead, more heat is evolved than by the mere oxidation of zinc by free oxygen gas. It is clear then that in the unstable chemical aggregation of the peroxide we have a store of energy which can be utilised in giving us voltaic cells of still higher electromotive force. The highly electro-negative (or oxidising) property of the brown peroxide of lead was discovered in 1835 by Munck, of Rosenschöld, who describes it as being the most highly electro-negative substance known, being superior even to the peroxide of manganese which Volta found so highly electro-negative. The peroxide of silver is still more highly electro-negative.

MINIMUM ELECTROMOTIVE FORCE FOR CHARGING.

The electromotive force of polarisation in a cell, evoked there by the passage of a primary current through it, will depend upon what chemical substances are produced at the two electrodes by the passage of the current. In the case of all ordinary liquids and metallic solutions, the products are known.

For each electrolyte there is a minimum electromotive force, without which, complete decomposition cannot occur. For water, for example, this minimum is 1·493 volts. If the current be of less electromotive force than this minimum, the action may begin, but the charging current will be stopped the moment the opposing electromotive force of polarisation has risen to an equal amount. It is for this reason that in charging a Planté cell, or a Faure cell, we must use at least two cells of Grove's or of Bunsen's battery, or at least three cells of Daniell's battery.

The chemical work that is done in any secondary battery, or electrolytic cell, is proportional to the strength of the charging currents, to the time it lasts, and to the effective minimum electromotive force of polarisation in the cell itself. It is not increased by increasing the electromotive force of the charging current much beyond this value; for though a higher counter-electromotive force may be temporarily called out, the work done against this added opposition is wasted in local heat, which is detrimental to the power of the cell. The cells should be charged with only just sufficient electromotive force to overcome their reaction. To charge a Planté cell, two Bunsen cells—not twenty—should be used. The storage will be slower, it is true, but it will be more economical, by far.

STORAGE POWER LESSENED BY HEAT.

Heat diminishes the counter-electromotive force of the cells during charging; it therefore diminishes the amount of chemical work done in charging them, and diminishes the amount of charge thereby stored. Secondary batteries should be kept as cool as possible during charging. A simple experiment in proof of the diminution of polarisation by rise of temperature is the following. Let a single Grove's cell be connected with a water-voltameter: no gases are evolved until the volta meter is heated to near boiling, when the gases come off freely. Bartoli examined the electromotive force of polarisation in a cell containing sulphuric acid with electrodes of platinum, and found it to be twice as great when the liquid was at 5° C as when raised to its boiling point. Beetz and Robinson have independently investigated the same effect, and their results agree precisely. Beetz found the polarisation 2·216 volts at the ordinary temperature of 20° C, and as the temperature was raised it fell off, gently at first, more rapidly afterwards, till at 100° C it was only 1·904 volts.

Temperature.	E.M.F. (Beetz.)	E.M.F. (Robinson.)
16° C	2·216	...
20°	...	2·216
30°	...	2·194
43°	...	2·148
53°	...	2·105
57·5°	2·101	...
60°	...	2·095
80°	...	2·040
94°	1·960	...
100°	...	1·904

IMPORTANCE OF SUFFICIENT CURRENT DENSITY.

The influence on the polarisation force of a cell of the size of the plates used as electrodes relatively to the strength of the charging current has also been investigated by several experimenters, amongst them Crova, Poggendorff, and Bunsen, and more recently by Bartoli and Blondlot. It is found that the degree to which a counter electromotive force or polarisation force is set up depends very greatly on the quantity of current per unit of surface of the electrodes employed. If the current be weak, and the electrodes large, the polarisation never reaches its maximum. On the other hand, if the electrodes be very small surface, and the current a strong one, the polarisation may attain abnormally high values. Thus Buff, electrolysing water with small platinum points, found the counter electromotive force to be no less than 3·57 volts. This difference between this and the minimum value of about 1·493, must be accounted for by the fact that the state of the liberated products varies with the condition of liberation. With greater "current density" the gases liberated by decomposing water are no longer simple oxygen and simple hydrogen. With greater current density, a greater proportion of the oxygen comes off in the more highly electro-negative condition of ozone, and more peroxide of hydrogen forms also round the anode, whilst at the cathode, the hydrogen which is evolved possesses in unusual degree the active properties attributed by chemists to "nascent" hydrogen; that is to say, a larger proportion of it probably is, at the moment of liberation, in some abnormal allotropic condition, bearing the same kind of relation to ordinary hydrogen as ozone bears to oxygen. The allotropic hydrogen is more oxidisable; the ozone more ready to oxidise. Their union would evolve more heat than the union of equal weights of ordinary hydrogen, and ordinary oxygen. It requires greater electromotive force to

keep them apart; their own tendency to unite is greater. J. Thomsen has even measured the heat value of ozone as compared with oxygen, and it takes its place in our table of elements at the bottom, below the peroxides, though chlorine and the haloids would be still lower on the list if they came within the scope of present considerations.

It follows from the above argument, that if we wish to make our storing cells exert their highest possible reaction, we must store them, using a current whose strength (or quantity) is proportioned to the size of the cell. If we use too weak a current, the maximum polarisation, and therefore the maximum efficiency, will never be attained. This is one of the rocks on which amateur constructors of storage batteries have come to grief. The current density is a most important consideration, especially in the early stages of the formation of the cells. It certainly should not be less than 50 milliwebers per square centimetre of surface in the cell.

EFFECT OF STATE OF SURFACE.

Again, the state of the surface of the electrodes has much to do in determining the state in which the gases are liberated, and the resulting polarisation force. Svanberg, in electrolysing water with copper electrodes, found the polarisation to be ·72 volts with smooth plates, and only ·47 with corrugated plates. Poggendorff, using platinum plates, found the maximum polarisation to be—with bright surfaces, from 2·28 to 2·50 volts; while with surfaces platinised, (*i.e.*, coated with a black, powdery deposit of platinum, the polarisation in cells, like those of Planté and Faure, where the original surfaces of the plates of lead are coated with thick films of peroxide, or of reduced metal,) these considerations do not apply, except for the first operation of charging. Indeed, I have found, experimentally, that there is a gain in scratching the leaden surfaces, before forming the coating of peroxide; the coating is more adherent, and the effective surface somewhat greater; advantages beside which the greater preliminary waste of liberated gases on first charging is comparatively trivial.

HISTORICAL SUMMARY.

Within one year after the discovery of the pile by Volta, two very important observations had been made. Nicholson and Carlisle, in 1800, discovered that the current so produced could decompose water;* and in 1801 Gautherot discovered that the wires of platinum or of silver which had been employed to thus decompose salt water acquired, and retained after being detached from the pile, the power of yielding a transient current, as could be proved by their efficacy in causing muscular contractions in a frog's leg, and in yielding the so-called galvanic taste. This is the phenomenon afterwards denominated "the polarisation of the electrodes." It was found to consist in a peculiar state of the electrodes which manifested its presence, even before the exciting current of the pile was cut off, by producing an enfeebling reaction against that current, the polarisation current being in a direction which opposed the exciting current. The phenomenon is well known to all electricians, and occurs not only in electrolytic cells, but in the cells of the voltaic batteries, where the liberation of hydrogen bubbles is accompanied by an opposing reaction of the same kind. Indeed, the difficulty with batteries has been to get rid of the polarisation.

In 1803, Ritter, of Jena, re-observed the same phenomenon, using wires of gold; and perceiving the importance of this reaction, he constructed a secondary secondary pile which we will presently describe.

The phenomena of the secondary currents due to polarisation were further investigated by Volta, Marianini, Davy, Grotthuss, De la Rive, Sinsteden, Becquerel, Schœnbein, Matteucci, Grove, Faraday, Buff, Beetz, and others. Matteucci and Grove in particular studied the reaction-currents set up by the presence of uncombined gases at the electrodes, and the latter constructed a well-known "gas battery." In 1869 M. Gaston Planté brought out a secondary battery constructed of lead-plates dipping into sulphuric acid, and in a remarkable and valuable series of classical researches he investigated the phenomena of their action. More recently, modifications of the Planté accumulator have been suggested by M. Camille Faure and M. A. de Méritens. These various systems will be described in detail presently. Professors E. J. Houston and Elihu Thomson, of Philadelphia, have made the suggestion which embodies the principle of reversibility in the case of the Daniell's cell. They place two horizontal copper plates in a cell containing sulphate of zinc in strong solution. To charge this cell, a current is sent through it from the top plate downwards. The upper plate or anode dissolves, forming a solution of sulphate of copper, which, being specifically lighter, floats on the sulphate of zinc. On the lower plate, metallic zinc is deposited; so that, when charged, this battery is merely a "gravity Daniell" battery. It will afterwards yield a current so long as there remains any zinc in the metallic state, or so long as there exists a chemical difference between the two electrodes. This suggestion has been modified by M. d'Arsonval, who uses an electrode of lead, or of carbon covered with lead shot along with an electrode of zinc in sulphate of zinc. In this case, when the cell is charged, zinc is deposited upon the zinc plate, while the lead becomes peroxidised.

Other suggestions have come still more recently from M. J. Rousse, who proposes the use of ferro-maganese, and of palladium as electrodes. The advantages offered by the former alloy over zinc do not appear to be great; and the cost of the latter metal is so enormous as to render suggestion valueless for practical ends.

RITTER'S SECONDARY PILE.

Ritter discovered the possibility of secondary voltaic action while studying the chemical action of electric currents upon liquids. He employed a large voltaic pile as his source of electricity, and observed, not only the decomposition of water into oxygen and hydrogen, but the phenomena of formation of peroxides, and of the deposition of metallic films at the anode and kathode respectively, when metallic solutions were employed. He found that his gold wires, after becoming covered respectively with film, if separated, oxygen and hydrogen could set up violent contractions in a frog's leg. He further investigated the phenomenon with different kinds of wires, and found platinum to yield the best result, gold coming next in order, then silver, copper, and bismuth. With lead, zinc, and tin, however, he obtained no result. He further showed that even after having been removed from the water and dried, the pair of gold wires retained their activity, and when afterwards plunged into water yielded a current in a direction opposed to that of the pile, by which they were originally rendered active.

One remarkable experiment of Ritter's found its way into English journals. Ritter took a *louis d'or*, and placing moistened cloth against its two sides, proceeded to pass through this combination a current from a powerful pile. The coin still laid in its wrappings

* Water had previously been decomposed by discharges from an electric machine in 1789, by Paetz van Troostwyk and John Cuthbertson.

was afterwards found capable of furnishing a current. This led Ritter to propound the view that conductors of electricity, such as the metals, could be charged with electricity; the coin between its metal wrappings being, according to him, analogous to the Leyden jar lying between its two coatings of tinfoil. He mentions also mercury, carbon, graphite, and binoxide of manganese, as being capable of receiving galvanic charges.

To produce the effects of galvanic charge upon a large scale, Ritter constructed a secondary pile *(Ladungs-Säule)*, consisting of a series of discs, of one metal—copper; separated by pads of cloth, moistened with a solution of salt, or sal ammoniac.

(To be continued.)

New Patents—1881.

4850. "Incandescent electric lamps." C. J. ALLPORT and R. PUNSHON. Dated November 5.

4854. "Improved means and apparatus, or appliances connected with the production, the storage, and utilisation of electricity for lighting or power purposes." J. B. ROGERS. Dated November 5.

4855. "Electric lamps." J. B. ROGERS. Dated November 5.

4866. "Voltaic or galvanic batteries." T. COAD. Dated November 7.

4867. "A new or improved cabinet for voltaic or galvanic batteries." T. COAD. Dated November 7.

4882. "Electric time-pieces. W. P. THOMPSON. (Communicated by A. Lemoine.) Dated November 8.

4883. "A new or improved electro-pneumatic apparatus for winding and regulating clocks." M. BAUER. (Communicated by C. A. Mayrhofer and W. Otto.) Dated November 8.

4885. "Improved means of insulating and protecting underground electric lighting wires and cables, and in water-tight boxes for the ends of such wires." W. C. JOHNSON and S. E. PHILLIPS. Dated Nov. 8.

4905. "Apparatus for the transmission and reception of sounds." W. C. BARNEY. Dated November 9.

4939. "Apparatus for producing light by means of electricity." A. F. ST GEORGE. Dated November 11.

4942. "Application of electric currents to the production of light." S. PITT. (Communicated by L. Goulard and J. D. Gibbs.) Dated November 11.

4948. "Electric lamps." G. G. ANDRE. Dated November 11.

4851. "An improved electro-motive engine." D. T. PIOT. Dated November 5.

5002. "Improvements applicable to dynamo-electric circuits." S. VYLE. Dated November 15.

5006. "A new or improved method and apparatus for regulating the production of electricity by dynamo-electric machines." F. WRIGHT and F. A. ORMISTON. Dated November 15.

5026. "Telephone receivers." F. H. W. HIGGINS. Dated November 16.

5028. "Telephone receivers." R. and M. THEILER. Dated November 16.

5050. "Improvements in apparatus for automatically transmitting and receiving signals for denoting places at which attempted burglaries and robberies may be made, and for other purposes." F. R. FRANCIS. Dated November 18.

5070. "A telephonic repeater." C. MOSELEY. Dated November 19.

5071. "Improvements in and connected with telephonic transmitting apparatus specially adapted for pantelephones." E. de PASS. (Communicated by L. de Locht-Labye.) Dated November 19.

5080. "Apparatus for the conduction and distribution of electric currents." R. E. B. CROMPTON. Dated November 21.

5096. "Electrical commutators." W. R. LAKE. (Communicated by F. Blake.) Dated November 22.

5104. "Electric batteries." A. M. CLARK. (Communicated by G. Fournier.) Dated November 22.

5126. "A new hermetical voltaic pile. R. H. BRANDON. (Communicated by C. A. Nyström.) Dated November 23.

5140. "Telephonic and telegraphic signalling apparatus." A. C. BROWN and H. A. C. SAUNDERS. Dated November 24.

5159. "Galvanic batteries and electro-chemical accumulators." R. E. B. CROMPTON and D. G. FITZGERALD. Dated November 25.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1881.

1393. "Electric drills." J. H. THOMSON. Dated 29th March. 2d. Relates to drilling machines operated by electricity, and which are specially adapted for use as portable drilling machines to be held up to the work by hand. (*Provisional only.*)

1412. "Manufacture of carbons for incandescent electric lamps." J. SCOTT and W. H. AKESTER. Dated March 31. 2d. The carbon filament is manufactured from the fibre which is used for the manufacture of brushes, and which is called in the trade "kitool." This fibre is coiled to any desired shape, and dried and heated so as to set it in that shape, it is then carbonised by exposure to high heat in a close vessel without access of air. The fibre is surrounded before and during carbonisation with fine sand or powdered charcoal, or other suitable material, so as to retain it in its position and prevent warping, and protect it from injury.

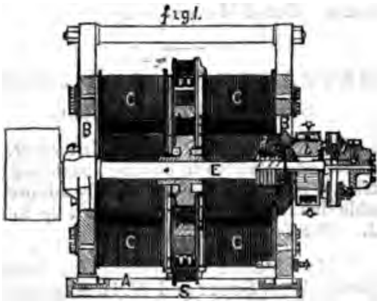
1422. "Production of electric light." WILLIAM CROOKES, F.R.S. Dated March 31. 4d. Relates to the preparation of the carbon for incandescence or arc lamps and also to the preparation of the glass inclosures for incandenscence lamps. The fibre or carbon is soaked in hydrofluoric acid, or in some chemical mixture equivalent thereto, or it is exposed to the vapour of hydrofluoric acid. After being soaked for some time the fibre is well washed in pure water till free from acid. The vegetable fibre, cotton, paper, thread, and the carbon made therefrom, treated in this manner has little or no ash when burnt. In the preparation of the vacuous inclosures for the display of electric light, copper or iron leading in wires are used instead of the usual platinum ones, and to avoid the difficulty from the difference between their rates of expansion and that of glass, they are coated with an enamel having an intermediate rate of expansion. In exhausting the glass vessel, there is introduced in the latter an earthy metallic or other body having great affinity for aqueous vapour or other gas, and capable of absorbing and holding it in a high vacuum and evolving it when heated. The vessel is exhausted to a moderate degree, then the earthy or other body is heated to drive off the occluded gas or vapour; the vessel is then re-exhausted. As the earthy or other body cools it absorbs the gas

which it formerly gave out and produces an exhaustion higher than can be obtained in the ordinary method of pumping by the mercury pump.

1442. "Electric batteries." FELICIAN ROLA DE WOLSKI. Dated April 1. 2d. The object of this invention is to reduce the internal or fluid resistance of the cells of electric batteries, to increase their electromotive force, to diminish local action, to render more constant both the electromotive force and the resistance of such cells, and thus to increase their efficiency, and diminish the cost of working. This is done by limiting the electric action to the opposing surfaces of the plates forming the electrodes of the cells, the reverse surface of either or both plates being rendered inactive, either by being coated with an insulating material, or by so arranging the elements in the cell as to render inactive the reverse surface of either or both plates. (*Provisional only.*)

1447. "Electric machines." CHARLES WILLIAM SIEMENS. (A communication from abroad by Messrs.

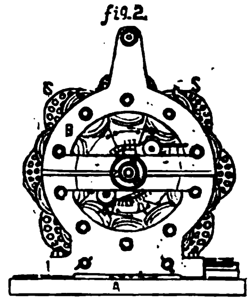
fig. 1.



Siemens and Halske, of Berlin.) Dated 1st April. 6d. Has for its object the construction of dynamo-electric or magneto-electric or electro-dynamic machines in such manner as to afford a continuous electrical current both as regards direction and practically also as regards strength. The essential feature of the invention is the combination to form a continuous current of separate electrical impulses that are generated immediately after one another at different parts of the machine; in machines hitherto constructed such combination can only be effected in impulses generated in consecutive magnetic fields.

Fig. 1 is a longitudinal section, and fig. 2 is a front or *end view of* a machine for the production of inter*mittent currents of like* or of alternate direction. On the base, A, are fixed two parallel sideframes, B, B, of circular form. On the inner faces of these frames are fixed projecting inwards from them, an even number (in this case 10) of electro-magnets, C. The inner ends of these magnets facing each other have polar extensions of suitable segmental form, and the polarity of each is opposite that of the pole of the magnet facing it, and of the poles of the magnets on each side of it, so that between each pair of tacing poles there is a powerful magnetic field of polarity opposite to that of the field on each side of it. Through these magnetic fields are caused to revolve bobbins, S, S, of insulated

fig. 2.



wire, wound on wooden cores of elongated shape, these bobbins being fixed on a wheel on the axis E, and being of such width as almost to touch the poles of the magnets, C, on each side of them. If when the number of coils, S, is the same as that of the magnets, C, as in machines hitherto employed, then all the coils have currents induced in them simultaneously as they approach, and leave the successive polar fields. According to the present invention however the number of coils, S, is made to differ by an even number from that of the fields, G, through which they pass; in the example given in figs. 1 and 2, there are 8 coils passing through 10 fields. The effect of this is that every pair of diametrically opposite coils is always in the same phase of induction, each successive pair being subject to a greater or less inductive influence, as the case may be, Thus the current does not, as in previous machines, attain its maximum or minimum strength in all the coils simultaneously, but successively in each pair of diametrically opposite coils. The wires of all the coils being so connected as to form a continuous circuit whilst they are wound on the coils alternately in opposite directions, the impulses in all the coils become added together. The axis of the machine carries a

fig. 3.

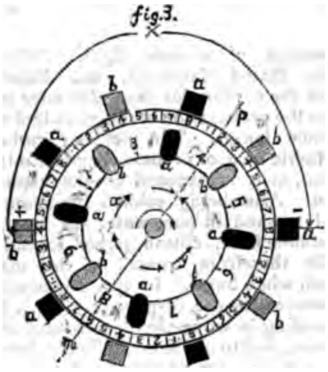


fig. 4.

fig. 7

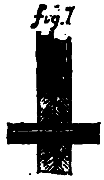


fig. 6

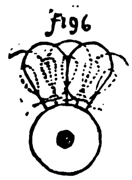
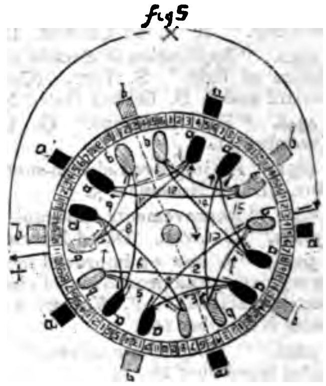


fig. 5



commutator, *t*, of ordinary construction, consisting, in the example given, of 40 insulated plates divided into 5 groups, each consisting of 8 commutator plates, each plate separated from the next of its own group by 7 intermediate plates. This grouping is effected by means of 8 insulated rings, *r*, fixed on the axis, to each of which 5 of the commutator plates are connected by 5 wires, *d*, and the rings, *r*, being connected each to the wire connecting 2 successive coils, the successive groups of commutator plates correspond in order with the successive connections of the coils. The currents are collected in the usual way by 2 opposite brushes which can be shifted more or less round the periphery of the commutator. The action of the machine may be more clearly understood on reference to the diagram, fig. 3, in which the outer squares, *a*, *b*, represent the 10 stationary fields of alternating polarity, and the inner ellipses, *a*, *b*, represent the 8 coils that revolve through them. The divided circle between these represents the commutator, having its 40 plates arranged in 5 groups, each containing 8 plates numbered respectively from 1 to 8. The numbers 1, 2, 3, etc., between the ellipses indicate the wires that lead from the connecting wire of each pair of adjoining coils to the rings, *r*, and thence to the commutator plates. Thus the wire, 1, is connected through its ring with all the 5 commutator plates marked 3, wire 2, with all the 5 plates marked 8, and so on. The arrows marked respectively + and — indicate the commutator brushes. It will now be understood that all the coils which are approaching fields marked with the same letters, *a* approaching *b*, and *b* approaching *a*, have currents set up in them in one direction which may be indicated by the arrows, *x*, and that all the coils approaching fields marked by different letters, *a* approaching *b*, or *b* approaching *a*, have currents set up of opposite direction, which may be indicated by the arrows, *y*. There will always therefore be in every situation of the coils as they revolve, a diametrically dividing line such as *p*, *m*, towards one end of which there is an accumulation of positive and towards the other of negative electricity. This line in the position shown in fig. 3, passes through the junctions 4 and 8, and as the brushes rub on the corresponding plates 4 and 8 of the commutator they take off the accumulated electricity. The imaginary line, *p*, *m*, always moves round in a direction opposite to that of the commutator and with greater velocity. For example, when the coils and commutator have moved $\frac{1}{40}$th of a revolution, the line *p*, *m*, will pass through the junctions 3 and 7, and thus the brushes are always in the proper position to receive the currents, which will obviously be the more nearly uniform the greater the number of fields and coils employed. Assuming n to be the number of coils, and $n + 2$ the number of fields, then $\frac{n}{2}(n + 2)$, or $n\left(\frac{n}{2} + 1\right)$ will be the number of commutator plates, such that there is always a pair of opposite plates corresponding to an opposite pair of connections between two successive coils. The number of fields might be less than the number of coils, that is to say, if the coils number n, the fields might number $n - 2$. Again, the number of coils might be doubled by arranging them in two planes overlapping each other, as shown by figs. 6 and 7, the connections being in that case arranged as shown by the diagram, fig. 5, in which the arrows indicate the directions of the currents to and from the several coils, and the numbers marked on the lines connecting the coils indicate the connections through the rings to the respective commutator plates, which in this case number 80, divided into 5 groups, each containing 16.

Instead of collecting the currents from a number of coils together as described, each separate coil might be arranged to deliver its current, and these currents which would be alternating might by means of known commutators be directed as successive currents, and collected into currents of constant direction; fig. 4 shows in perspective a single coil with a commutator arranged for this purpose. A number of such commutators might be arranged on the axis of the machine, and their respective brushes, *f*, *f*, connected as desired.

The claims made under this patent are as follows:—

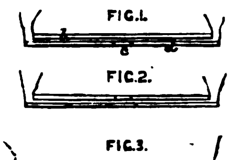
First. Combining with an even number of stationary magnetic fields of alternating polarity, a number of revolving alternately wound coils differing by two or other even number from the number of fields, the wires of the coils being all connected to one another and to a commutator, substantially as and for the purposes herein set forth.

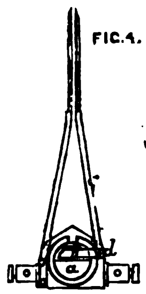
Second. In a machine arranged in the manner referred to in the preceding claim, the use of a commutator the plates of which are combined in groups, each containing as many plates as there are revolving coils, substantially as and for the purposes herein set forth.

1474. "Apparatus for laying underground telegraphic or telephonic conductors." J. C. MEWBURN. (A communication from abroad by Bourdin, and General Serge Ivanowitch de Maltzoff, of Paris. Dated April 5. 2d. The object of this invention is to construct an apparatus by means of which underground conductors can be very rapidly and economically laid. The new or improved apparatus is composed of a sort of carriage carrying a reel upon which the conductor to be laid is wound, and a share, somewhat resembling that of a draining plough, the nose or point of which makes the channel for the conductor, and the body of which has a hole through which the conductor as it unwinds from the reel passes, issuing at the rear of the share into the bed which the nose has prepared for it. (*Provisional only*.)

1526. "Electric lamps, &c." J. D. F. ANDREWS. Dated April 7. 6d. Fig. 1 shows one form of the lamp; *a* and *b* are two carbon discs fixed parallel to each other at a little distance apart, one of these carbons, *a*, having a countersunk central hole, *c*, and being connected to the conductors at its outer edge, while the other carbon, *b*, which has no hole, is connected to the conductor at its centre, or it may be at its edge, as shown in fig. 1. The arc then presents itself at the edge of the countersunk hole, and moves round it as the carbon consumes, or may be made to revolve round it by inductive action from a neighbouring coil or magnet. Both carbons may have central countersunk holes, as shown in fig. 2, and be connected to the conductors at their outer edges. When parallel plates of carbon are used, these plates are connected to the conductors at their opposite ends, as shown in fig. 3, the one extending beyond the other, so that the arc presents itself between the edge of the one and face of the other carbon. When two carbon plates are employed, the one plate is fixed and the other, or part of it, is set on a frame pivoted below, so that the upper edge of the movable carbon plate can approach to or recede from that of the fixed plate; the kindling of the arc and the regulation of the distance of the upper edges of the plates is effected as shown in fig. 4. In the base of the lamp an electro-magnet is fixed, the core of which is divided lengthwise into two parts, *a* and *b*, each somewhat less than a semicylinder. One of these half cores, *a*, is fixed and the other *b* is connected to the frame, *c*, of the carbon plate, which frame is pivoted at *d*. The coil surrounding the two half cores, *a* and *b*, is in the circuit of the lamp. When there is no current the weight of the frame and upper half core keeps the two half cores nearly close together, the

upper edges of the two carbon plates being then in contact. When a current passes through the coil and carbons the two half cores become magnetic, and having corresponding poles next each other, the movable half core is repelled from the other, and the edges of the carbon plates being thus separated the arc





is established. Should the carbons be too far apart the electro-magnet becomes weakened, allowing the half cores, *a* and *b*, and consequently the carbons to approach each other; or should the carbons be too near the electro-magnet acquires more power to cause repulsion of the half cores, and they and the carbons become consequently separated.

1536. "Electric lamps." J. L. A. DUPONT-AUBERVILLE. (A communication by Victor Delaye, of

FIG. I.

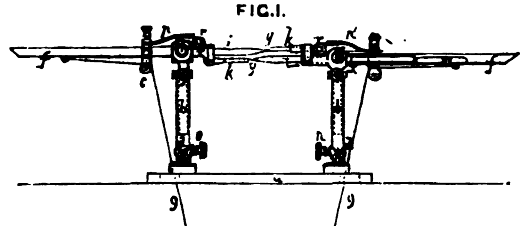
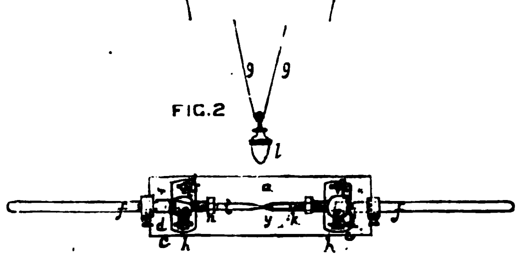


FIG. 2



Paris.) Dated April 8. 6d. Fig. 1 shows an elevation partly in section of a lamp embodying the invention; fig. 2 shows a top view of the same; *a* is the bed or base of the lamp, upon which are erected two hollow supports, *b*, which may be moved along grooves, *c*, and set by thumb screws, *d*. Two rods carrying sockets, *e*, are introduced in supports, *b*; carbon-holders, *f*, slide in these sockets. The carbon holders may be moved horizontally or vertically by unscrewing the screws, *g*, and they may be turned or moved lengthwise by uncrewing the screw, *h*. In the carbon holders are placed the electrodes, *i*, the forward ends of which abut respectively upon abutments or blocks, *k*, made of any suitable non-conducting and refractory material. The electrodes, *i*, are pressed against their respective abutments by springs, or (as shown in the figure) by a weight, *l*, attached to cords, *q*, passing round pulleys, *s*, and acting upon rods or plungers, *m*. The electric current enters the lamp by terminals, *n* and *o*, and is passed through the electrodes by plates, *p*, provided with friction rollers, *r*. As shown in the figure the two electrodes, *s*, are parallel to one another, and their tapering extremities overlap each other. The result of this arrangement is that only the parts, *x*, *y*, of the electrodes are heated. The voltaic arc is formed between the electrodes, *i*, while the abutments, *k*, become incandescent, increasing the power of the light and imparting to it the quality and colour of sunlight. The electrodes, *i*, being permanently pressed upon the blocks, *k*, the ashes, when carbons are employed, drop away as they are produced, and thus the light is free from the variation or irregularity to which ordinary lamps are subjected, and which often produces extinction.

The following are the final quotations of stocks and shares for Nov. 18th.:—Anglo-American, Limited, 53¼-53¾; Ditto, Preferred, 81-82; Ditto, Deferred, 23¼-23¾; Brazilian Submarine, Limited, 10⅞-11⅛; Brush Light, £4 paid, 7¼-7¾; Ditto, £10 paid, 16⅞-17⅜; Electric Light, 1⅛-1⅜; Consolidated Telephone Construction, 1-1¼; Cuba, Limited, 9½-10; Cuba, Limited, 10 per cent. Preference, 16-17; Direct Spanish Limited 5¼-5¾; Direct Spanish, 10 per cent. Preference, 14⅞-15⅜; Direct United States Cable, Limited, 1877, 10⅞-11¼; Debentures, 1884, 100-103; Eastern Limited, 10-10¼; Eastern 6 per cent. Preference, 12⅛-12⅜; Eastern, 6 per cent. Debentures, repayable October, 1883, 100-103; Eastern 5 per cent. Debentures, repayable August, 1887, 100-103; Eastern, 5 per cent., repayable Aug., 1899, 105-108; Eastern Extension, Australasian and China, Limited, 10⅞-11; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 108-111; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 102-105; Ditto, registered, repayable 1900, 102-105; Ditto, 5 per cent. Debenture, 1890, 100-103; Eastern and South African, Limited, 5 per cent. Mortgage Debentures, redeemable 1900, 102-105; Ditto, ditto, to bearer, 102-105; German Union Telegraph and Trust, 10¼-10¾; Globe Telegraph and Trust, Limited, 6½-6¾; Globe, 6 per cent. Preference, 12⅝-12⅞; Great Northern, 12¼-12¾; 5 per cent. Debentures, 103-106; India Rubber Company, 24-25; Ditto, 6 per cent. Debenture, 104-108; Indo-European, Limited, 27⅞-28⅛; London Platino-Brazilian, Limited, 4-5; Mediterranean Extension, Limited, 2½-3; Mediterranean Extension, 8 per cent. Preference, 9½-10; Oriental Telephone, ¼-½; Reuter's Limited, 12-12½; Submarine, 290-300; Submarine Scrip, 2⅛-2⅜; Submarine Cables Trust, 97-100; West Coast of America, Limited, 4⅞-5; West India and Panama, Limited, 1⅛-1⅜; Ditto, 6 per cent. First Preference, 7⅞-8; Ditto, ditto, Second Preference, 6¼-6¾; Western and Brazilian, Limited, 7⅛-7⅜; Ditto, 6 per cent. Debentures "A," 110-115; Ditto, ditto, ditto, "B," 97-101; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 123-128; Ditto, 6 per cent. Sterling Bonds, 104-107; Telegraph Construction and Maintenance, Limited, 28-29; Ditto, 6 per cent. Bonds, 104-108; Ditto, Second Bonus Trust Certificates, 1⅛-1⅜.

THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

VOL. IX.—No. 214.

LEGISLATION FOR CABLE PROPERTY.

THERE has been much correspondence lately in the leading newspapers respecting submarine cables and the laws necessary for their efficient protection.

The value of the cables now existing is so immense, intrinsically, imperially, and commercially, that probably no one who knows anything of the subject will be found to deny the desirability of International legislation, both to keep as far as possible those cables in repair, or when broken, to facilitate their restoration rapidly to their usual working condition.

After carefully considering the various questions which present themselves for examination in connection with this subject, we would suggest that the attainment of the above objects might be greatly assisted if laws were passed to enforce, in the first instance, a respect for the rights of "first comers" to a cable ground, and in the second, by obtaining for cable ships a freedom from those Custom House formalities at present obtaining in many countries.

The question of the protection of cables is a very wide one, and includes not only protection from the damage that may arise from anchors and fishing operations, but also from the injury which may ensue from laying cables too closely together.

Pre-supposing that legislation had been effected, then if in relation to our first suggestion we consider the subject of damage from anchors, the matter would simply resolve itself into the legal question—*was the cable laid over a generally accepted anchorage, or did the ship anchor on what was legally defined as cable ground?*

In the case of fishing operations, the question for consideration would be "*was the cable laid over a well-recognised fishing ground, or was the fishing carried on over cable ground?*" Admit now for the sake of argument, these methods of regarding the questions, and then let us suppose that it is necessary to lay a cable through a recognised fishing ground; it is evident that by so doing, the laying of the cable must depreciate the value of this resort of fishermen, and it would consequently be but fair and just that an indemnity should be paid to the association representing these fishermen, who, in this case, must be considered the "first comers." This indemnity would purchase for the cable a right in that ground, and it would consequently be perfectly justifiable afterwards to recover the total amount of any damage done to such cables by the fishermen, from the fishing association which granted the said indemnity. Of course, in the reverse case, a similar law might be made to apply in an equally just manner, as for instance, if fishermen were to encroach on what, by virtue of being first comers, might be termed cable ground; then it should be legally possible to obtain redress from them, through their association, for trespass and consequent damage to the cable property. An almost parallel arrangement could also be applied to the right of existing cables over those of any lines which it might be desired afterwards to lay.

Cable ground might, perhaps, with advantage be defined as one mile on either side of the cable at the beach, and seaward for the distance of ten miles, and two or three miles on either side beyond that distance from the shore. It would also be desirable to rule that no fishermen should be permitted to fish closer to the lines than the distances given above, without a special license from the company owning the cable, and that no ship should be allowed to anchor inside those distances without a similar license, also that no new line should be laid closer than the aforesaid distances.

Should however it be absolutely necessary for new cables to be laid closer than these limits, or even to cross a pre-existing line, we would in such cases suggest that a fair indemnity should be paid to the said first comer for this encroachment on its rights, and consequent depreciation of its property.

In considering our second suggestion, it will be well, perhaps, to point out the difficulties which it is desired to remove thereby, and to cite a few of the experiences of those who have had to face, and eventually overcome, them; and afterwards to give as briefly as we can the method in which we think those difficulties may with future legislation be avoided.

The India Rubber Company's ship in repairing one of the Direct Spanish Telegraph Company's cables put into Santander, and before *pratique* could be obtained, enabling her to go on with her work in the port, lists of all the steward's and other stores on board had to be drawn up and handed to the Custom House officials. On this particular occasion the cargo on board was stated as a small quantity of submarine cable and ballast. Owing however to the ship occasionally anchoring in Santander Harbour, sometimes in Bilbao Bay, and at others for the sake of shelter under Cape Machichaco, she was not in strict accordance with the Custom House laws of Spain, and before she was able to clear for the return voyage to London, the Spanish Administrator insisted upon

Mr. Saint Martin, the company's agent, giving a bond that the statement as to what was on the ship was correct. Mr. Saint Martin wrote to his company for a certificate that the cable and ballast which the ship had on board at Santander did in reality arrive in London, saying that this certificate was necessary to free his bond. In the end, we believe, the company had to get Senor Aparicio to ask the Minister in Madrid to give special instructions in the matter to the Chief of the Customs in Santander, which he eventually did. The enormous trouble involved in this case is self-evident.

In the following year the India Rubber Company again had to send a ship there, but as there was sufficient time, between the break of the cable and her arrival on the ground, to obtain a special permission from the Minister in Madrid, the delay which otherwise might have ensued was avoided. Even in France when laying the Marseilles-Algiers cable, some trouble and considerable delay was experienced, because the Chief of the Customs in Marseilles was not quite satisfied with the general instructions sent to him from the Minister in Paris.

But perhaps one of the worst instances we can give occurred during the operations of the late Mexican cable expedition. Brazos Santiago is an open roadstead, near the mouth of the Rio Grande river, and being in Texas, consequently comes under the United States Customs laws. When the *Dacia* arrived off Brazos, it was necessary to land some testing instruments and the testing hut, the value of the instruments being about £120. When the instruments were landed they had to be passed through the Customs, where much formality had to be gone through, and tonnage dues to the amount of £118 paid. This sum is a charge made irrespective of the value or quantity of material landed, and depends completely on the size of the ship. During the time these business arrangements were being carried out, bad weather set in, and as there is a heavy bar to cross, between the ship's anchorage and the landing stage, which bar is at times impassable for several days together, the ship was compelled to lie outside, waiting till it again became possible to communicate with the shore.

Many instances of a similar kind might be given, but the foregoing are sufficient for the purpose of illustration.

The remedy for this state of things, involving as it does annoyance and needless loss of time, is very simple, as all cable ships should undoubtedly be placed on the same footing as Government vessels, so far as custom formalities are concerned. The Brazilian Government, we believe, is the only one which has thoroughly recognised the difficulties which must arise if cable ships are placed on the same footing as vessels carrying ordinary merchandise. The *Norseman*, the repairing steamer of the Western and Brazilian Company, is allowed to go into or out of harbour without the usual Custom House routine, and in fact the existence of the ship is almost ignored by the Custom House Officials, the only rule observed being one more of etiquette than anything else, namely, that the senior naval officer in the port has an intimation given him that the ship has to proceed to sea for cable repairs, and that is a task which is easily accomplished whilst steam is being got up.

We may mention that the ss. *Retriever*, on the West Coast of America, finds very little difficulty with the Customs, as the Governments of Chili and Peru have always given a general order to the different Custom authorities in the ports of those countries to allow this vessel to go in and out and to carry on operations in the ports without any interference.

An International recognition of cable ships is very desirable in the interests alike of the public and of those connected with the repairing operations, as every day saved means a more speedy re-establishment of telegraphic communication.

The question of legislation is one which must eventually *force* itself on the attention of governments, and it is therefore desirable that steps should be taken in this direction at once. Every nation is interested in the maintenance of cable communication, and that almost in a certain, direct proportion, the factors determining that proportion for each country being its colonial extensions, its naval superiority, and its commercial relations.

Great Britain must of course stand amongst the nations most deeply interested, not only on account of her colonies, her naval stations, and her mercantile transactions, but also because her shores form a centre to which all the principal lines of telegraphic communication throughout the world converge. We venture to hope that the British Government will speedily take upon themselves the duty of initiating international legislation on the subject of cable property, in which all civilised (and we might almost say, all uncivilised) peoples are interested; in so doing they will adopt a course which must commend itself to the mind of every enlightened person throughout the universe.*

In reference to the above article it will be of interest to note the number and tonnage of the ships engaged in cable laying and repairing, as some idea of the importance of such operations may be gathered therefrom.

	Names.	Gross Tonnage.
SS.	Agnes	781
,,	Ampère (French Government)	—
,,	Calabria	3,325
,,	Caroline	526
,,	Charente (French Government)	—
,,	Chiltern	1,304
,,	Dacia	1,856
,,	Duchess of Marlborough	402
,,	Edinburgh	2,315
,,	Faraday	4,908
,,	Grappler	868
,,	Great Northern	1,352
,,	International	1,380
,,	John Pender	1,213
,,	Kangaroo	1,773
,,	Minia	1,986
,,	Norseman	1,372
,,	H. C. Œrsted	570
,,	Pouyer-Quertier	1,385
,,	Professor Morse	1,023
,,	Retriever	459
,,	Retriever	624
,,	Scotia	4,667
,,	Seine	3,579
,,	Sherard Osborne	1,429
,,	Silvertown	4,935
,,	Lady Carmichael	369
,,	Patrick Stewart	1,130
		45,629

* *We note, as we go to press, that it is proposed for the Telegraph Companies collectively to send a letter on the above subject to Lord Granville, and that this letter shall be followed up by a deputation, to be introduced by Mr. Pender, M.P.*

THE EFFICIENCY OF ELECTRIC LAMPS.

A REPORT bearing the above title was made to our contemporary, the *Engineer*, during the Paris Electrical Exhibition, by Professors Ayrton and Perry. This paper is now reprinted in separate form, and will doubtless form a subject of the greatest interest to electric light engineers and all others directly or indirectly connected with this new enterprise. We have had long and exhaustive reports on the efficiency of the dynamo machine itself by such competent authorities as Mr. Schwendler, Dr. Hopkinson, Professors Houston and Thomson, and others; and this subject has been minutely dealt with from all points. But the credit of first considering the efficiency of the lamps themselves employed in the various systems of electric lighting must be awarded to Professors Ayrton and Perry, and we can only regret that the results given by these gentlemen in comparing the numerous lamps shown in their table No. 2, which we print, and which is the only one we shall consider at present, should have been obtained under such difficulties, and that they were unable to take more than single tests on most of the lamps submitted to them; and we think that under the circumstances the report should not be looked upon as authoritative until it has been confirmed or modified by future tests of their own and those of other observers.

TABLE II.—*Experiments on some Electric Lights in the Paris Exhibition. All lights measured horizontally.*

Name.	Electromotive force in Volts between the two terminals of lamp.	Current in Ampères flowing through lamp.	Horse-power expended in the lamp.	Candle-power.		Candles per horse-power.		Mean candles per horse-power.
				Green.	Red.	Green.	Red.	
Crompton ...	37·7	25	1·26	2916	1849	2314	1467	1890
Joel, Semi-incandescent	6·6	44·2	0·39	70	60	179	154	166
„	7·1	45·0	0·43	75	70	174	163	168
„	6·6	50·0	0·44	75	68	170	155	162
Pilsen	36 8	10·33	0·48	780	512	1625	1066	1345
Brush	38	10	0·51	2025	961	3970	1884	2427
Sautier - Lemonnier. One lamp on A Gramme Machine ...	40	43	2·3	15376	5625	6685	2446	4565
Ditto	45	42	2·54	15376	9025	6054	3553	4803
Maxim Incandescent	53·6	3·32	0·24	135	120	562	500	531
Maïkoff	45·3	8·3	0·50	397	307	794	614	704
Sautier - Lemonnier. One of ten lamps on H Gramme Machine ...	40	12·5	0·67	540	310	806	463	634
	„	„	„	*784	125	1170	187	670
Gravier	46·6	9·2	0·58	1023	349	1173	604	1189
Serrin	31·1	35·8	1·49	2448	938	1616	630	1123
Cance	51·8	16·7	1·16	3445	1156	2970	997	1983
Weston	33·7	21·7	0·98	2663	1024	2717	1045	1881
Maxim Incandescent .	73	2·5	0·244	350	290	1434	1189	1311
	77	2·8	0·294	270	262	934	886	910
	77	2·8	0·294	350	350	1211	1211	1211
	81·3	2·8	0·305	422	350	1383	1148	1265
	85·3	3·3	0 377	512	360	1358	954	1156
Engine and dynamo machine running at higher and higher speeds	88	3·6	0·424	870		2050		
	105·5	4·6	0·650	1225		1883		
				†1370				

* This measurement of light was made on Rumford's method.
† This lamp now broke.

Some of the figures shown appear to be most contradictory, and we shall presently draw attention to those we think most important, and which we can only consider to be the results of errors in observation, which might easily occur from the hurried way in which the tests were made. Before doing this, however, it will be well to notice some other points in connection with this report. The idea of measuring the efficiency of the lamp itself without any reference to the machine producing the current, whether it (the machine) be good or bad, is of great value, and will set inventors of lamps considering whether they have given enough attention to the construction of their apparatus, so that all the current passing between the terminals of the lamp may be utilised in the arc itself, and not wasted in passing through extraneous resistance, whether such be due to wire coils in the circuit, bad contacts, bad and loosely fitting carbons, or any similar reasons. That some lamps are much better adapted for utilising the current passed through them than others is very evident, and we wish to call the attention of all electric light engineers to this important fact, which has certainly been overlooked up to the present, and which can now be studied by the method of testing the horse-power taken up by the lamp, and which any electrician can do for himself.

The new Dispersion Photometer devised by Messrs. Ayrton and Perry cannot well be criticised without giving details of the instrument, and it will be therefore wise to reserve judgment upon its efficiency until we have more particulars concerning it before us.

A plan of the instrument showing the internal arrangements would have been much more satisfactory than a perspective view of the outside. However, we may return to this on a future occasion and therefore we will not discuss now its merits or demerits, but content ourselves by reminding inventors of the different systems tested that whatever may be their opinions as to the comparative values of tests made by this photometer, and by the direct distance measurements, whether by illuminated screens or by comparing shadows, it was the only one used for the Paris results, and therefore each lamp is judged upon its merits, the form of photometer not entering into the question as long as all lamps are compared by the same instrument. Regarding the electrical apparatus used for measuring the current between the terminals of each lamp, the new ampère-meter seems to give correct results when tried in connection with a Siemens dynamometer, and we may therefore take it for granted that the quantity of current passing through each lamp is correctly stated. We think that in measuring the electromotive force of the current errors might have crept in. A dead beat galvanometer of 110 ohms resistance was used for this purpose, but not having enough resistance in itself for acting as a shunt to an electric lamp an additional resistance, varied in different experiments, was used.

This additional resistance might not have been correctly read off in some cases and thus the difference of potentials between the terminals might probably in particular instances be erroneous. That some such mistake occurred we feel sure; the deflections of the needles of both the ampère-meter and the dead beat galvanometer might not have always been accurately recorded, and probably to save time, instead of fixing the wires to the actual terminals of the lamps, they might have been merely placed against some portion of the lamp, and we need hardly remark how necessary it is in electric-lighting matters to secure good and clean connection.

Turning now to the before-mentioned table, No. 2, we will call attention first to the following statement regarding the performances of two well-known arc lamps, the "Brush" and the "Pilsen." Measurements between the terminals of these two lamps gave the following results:—Electromotive force in volts: Brush 38, Pilsen 37; current in ampères flowing through lamp: Brush 10, Pilsen 10·3; horse-power expended in lamp: Brush ·51, Pilsen ·48. It will be seen that for all practical purposes the electrical conditions of the two systems were identical, and of course the resistances between terminals must have been practically the same, and one would expect that the lights produced would also be equal; but we are told that observations through a green glass gave, Brush 2,025 candles, the Pilsen only 780; through a red glass, Brush 961 candles, the Pilsen 512; and that the candles per horse-power expended in the lamps = Brush, observed through green glass, 3,970 candles, through red glass, 1,884, the mean result being 2,427 candles; whilst the Pilsen lamp gave, when observations were taken through green glass, 1,625 candles, through red, 1,066, the mean result being 1,345 candles, or a little more than half that of Brush. Now this result, if true, could only occur through either an extraneous resistance in the Pilsen lamp absorbing a great part of the current passing through it or through an error of observation, and to this latter we must attribute the astonishing result, for it seems that the difference of observed candle-power in red glass and green, is, in the Brush system, as 1 : 2·10, whilst in the Pilsen, instead of getting the same proportion, we have the curious figures of 1 : 1·52. Is this due to errors in reading off the results or to any defect in the photometer? Both lamps have a solenoid of thick wire in the main circuit, and each has a shunt coil of nearly equal resistance, we believe. Brush uses carbons coated with a film of copper to lessen the resistance, which is not much in any case; whilst the Pilsen system has the ordinary carbon pencil.

We do not know whether the respective carbons employed vary in size, or if the measurement on the Brush lamp was made when the carbons were nearly consumed and that on the Pilsen when just started, but we believe that the readings for the Pilsen system were obtained early one evening, whilst the Brush system was not tested until after 11 o'clock, when everything was quiet and all other machines and lamps stopped. But in any case, the two lamps appear to be so alike in resistance that we should certainly have looked forward to seeing the same candle-power from each, and until we see the results of further tests it would be unfair to *suppose the* Pilsen lamp inferior to the Brush; for *if the carbons of the* former, during the hurried test it was submitted to, should have been burning in such a position that the greater part of the light was sent in an opposite direction to that in which the photometer was placed, it is obvious that a second test might have given entirely different and better results.

Take another instance—the Crompton system. We are not aware that this lamp has any considerable resistance independent of that in the arc itself to absorb any large part of the current passing, yet with the same electromotive force as the two before-mentioned lamp, and a current of 25 ampères flowing, 2½ times more quantity than either the Brush or Pilsen, and absorbing 1·26 horse-power in the lamp, we only get a candle-power per horse-power of 1890 or about ¾ that of Brush.

A still more astonishing result is shown in measuring the Sautier-Lemonnier lamp. The electromotive force is given as 40 volts (a trifle more than was shown in the Brush), the current in ampères 12·5, the above remark applying to this also, and the horse-power absorbed in the lamp ·67, yet this lamp only gives a mean result per horse-power of 634 candles. This was one of a circuit of 10. Another test of a similar lamp worked singly from a Gramme machine, and absorbing 2·3 horse-power with a current of electromotive force 40 volts and ampères 43, gives a mean measurement of 4,565 candles per horse-power, and another lamp tested in a similar way gave nearly the same figures.

These results are more like those we have been accustomed to see, for although somewhat high it must be remembered that Messrs. Ayrton and Perry particularly call attention to the fact that their photometer gives higher readings than those obtained by the ordinary methods of photometric measurement; but for all that, we observe that in several tables, to which we shall refer in a future article, their results in numerous experiments and those obtained by using Rumford's method agree very well and that in some instances the latter results are highest. But even here again we observe the same discrepancy existing in the observations through red and green glass which we pointed out in the case of the Brush and Pilsen. Both lamps give 15,376 candles seen through green glass, but one is stated to give through red glass 5,625 candles and the other 9,025. We might cite other instances of the great discrepancy existing in the observed candle-power of lamps which are in almost identical electrical conditions as to the current passing between their terminals, and we can only reiterate our statements that these varying results can only be due to either errors of observation in the various instruments employed during the tests or to an extraneous resistance in certain of the lamps absorbing a great part of the current; but as we do not see where or how this latter could be in the lamps named, we must reluctantly come to the conclusion that although such a series of tests would have been invaluable had there been sufficient time to take a number of observations on each system submitted, the present report from the Paris Exhibition is only of value in suggesting future measurements.

As far as casual observation goes, it was the opinion of many competent authorities that the Pilsen lamp held its own with all competitors in the Paris Exhibition, and that it gave as good a light at

any time as the Brush. Indeed, the Pilsen was the theme of general conversation when speaking on such matters, and was looked upon most favourably by all, and by many as the best arc light shown. But as we have before mentioned, a single test taken by an observer in a hurried manner and surrounded by the curious is not to be relied upon, and as those interested commercially in the economy and efficiency of the different methods may not be conversant with the numerous causes which may affect the measurements obtained, and will only look to the column in the Professors' table of results which give the candles produced per horse-power, we will say to such of the public or profession generally, that only exhaustive and numerous experiments by various competent observers should be seriously considered, and that the same conditions should obtain for each system tested.

Returning again to the photometer, we do not think that the difference of colour existing between the standard candle and the electric light is entirely eliminated by the method of observing through red or green glass, and we are also of opinion that different observers would get varying results with Professor Ayrton and Perry's apparatus, just as is always, or nearly always, the case in ordinary photometric observations.

The short distance employed between the end of their photometer and the source of light is in itself objectionable, for a slight error of measurement would tell for or against a lamp to a serious extent.

We feel sure that from the absence of any critical remarks by Messrs. Ayrton and Perry on the Paris tests, they are themselves dissatisfied with the figures obtained, which certainly cannot be reconciled with one another. It would be most interesting to hear from these gentlemen their opinion on the curious and contradictory results obtained with different lamps under the same electrical conditions, and which, if burning the same lengths and sizes of carbons should have given like results. Other columns might with advantage have been added to their table giving such items, and particularly a column for stating the number of lamps in each circuit when the tests were made.

The other portion of the report, which is independent of the Paris Exhibition, is of great value, the experiments being numerous and exhaustive in nearly every detail; the experiments with the Maxim lamp being especially full and interesting. It may surprise many that these lamps have given 1,000, 1,100, and 1,200 candle light per horse-power, but it is only a question of producing a carbon or other filament capable of bearing the necessary heat without breaking to raise its illuminating power to such a point. We shall hope to deal with this and the remaining portions of the report in our next issue, and we can only express our regret that as far as the Paris Exhibition tests are concerned, the results will be found more misleading than valuable, and we trust that Professors Ayrton and Perry may have future opportunities of making many observations on each of the lamps described by them, so that we may really have something definite to work upon, for up to the present there is a great vagueness in nearly all matters connected with electric lighting.

In conclusion, we will draw attention to the want of definition between the intensity and quantity of a light. We should have this defined as we have it in regard to electrical currents. A light may be of great intensity but of little volume, or the reverse.

THE PARIS ELECTRICAL EXHIBITION.

THE BRITISH SECTION.

REID'S FIRE ALARUM AND TELEPHONIC SIGNALLING APPARATUS.

IN this system, designed by Thomas Reid, jun., of Dundee, a loop of two wires is carried throughout a district, and led into a central station. Any number of signalling apparatus may be joined on to the loop without any additional battery power being required beyond what is necessary to work the signaller farthest away from the station.

In a convenient position outside the buildings is placed the alarum, fig. 1, from which the wire, 12, is led into all parts of the building; parallel to 12 is the wire, 24, which leads from the transmitter studs, 21, 24, to the earth. Communications between these wires can only take place by the heat acting on contacts kept apart by fusible plugs, or by contact being made by the action of heat on a compound metal strip. The time of contact may be regulated to any degree of heat.

In fig. 1, 22 and 23 indicate telephone studs; 21 and 24, transmitter studs; 25, a connection between a brass plate and an electro-magnet terminal; 16, a pin for a lifting contact weight, 17; on this contact weight are cut a number of notches, which make contact with the line wire spring, 15, when the weight drops, thus sending a combination of Morse signals for indicating the locality in which the instrument is placed; 13 is a contact spring connected to earth; 14 is a contact stud, also to earth. In the brass plate is a slot, 26, in which can slide the pin; 20 is a telephone; 27, a spring for pressing the lever 19 in contact with the insulated earth contact stud, 18, when the telephone is lifted off the lever; 28 is a spring which keeps the weight, 17, raised by means of the small projection, 29 (fig. 1 A), hanging on to plate 30, and keeps contact with the plate when the weight falls; 31 and 32 are connections from electro-magnet terminals to the starting wire; 33 is a contact spring; and 34 a contact stud for completing the circuit of the line wire; 30 is an insulated plate screwed to the guides, 35 and 36.

In fig. 2, 1 and 1 are contact studs for the starting wire; and 2, 2, are contact studs for the belt at the alarum station; 4 is a spring for completing the circuit between the contact studs; 3 is a catch for keeping 4 out of contact with 1 and 1, when the current is passing along the line wire; 6 and 6 are line wire studs for the electro-magnet, 5; 7 is a battery; and 8, Morse instrument and telephone connections.

The current from the battery passes along the starting wire by means of the spring, 4, in contact with 1 and 1; it then passes down to contact spring, 31, 33, and 34, along to the successive instruments

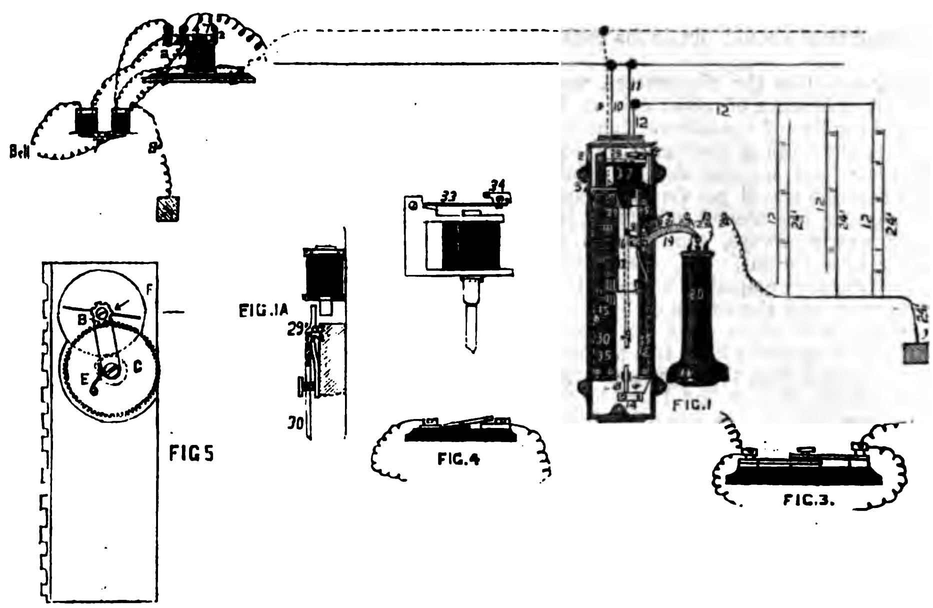
in circuit. If contact should be made between 12 and 24, the current will pass through the electro-magnet by the terminal, 25, to the plate, 30, and to contact spring, 13, thence through 15 to the earth-wire, 12, 24. The electro-magnet, 37, will then break the circuit of all the instruments further away than itself by attracting the contact spring, 33; it also liberates the contact weight, 17, by pulling back the spring catch, 28 and 29. In falling the weight comes in contact with spring, 15, of line wire, the current passes through the electro-magnet, 5 (fig. 2), to line wire, and through 15, 13, 12, 24 to earth, throwing the starting wire out of circuit by breaking the contact of 4 with 1 and 1, throwing the bell in circuit by contact of 4 with lower contact studs, 2, 2, the catch, 3, keeping 4 in contact with 2, 2, until removed. The makes and breaks of the contact weight are recorded by a Morse recorder or other dot and dash signalling instrument, through which the current passes to the earth. In order to cause the weight to descend slowly, and thus make the signals lengthened and distinct, a train of wheels connected to a "fly" is contained in the weight; this train gears into a rack, down which the weight slides (fig. 5).

After the signal has been recorded, the attendant liberates the catch, 3, thus completing the circuit of the starting wire, which had been interrupted by the weight having lifted the contact spring, 13, out of contact with the earth stud, 14. Any other instrument can now signal, but no two instruments can signal at same time.

The telephone signal acts thus:—The person wishing to communicate with the station lifts the telephone from the lever, 19, the spring, 27, moves the lever, 19, into contact with the stud, 18, just above it, completing the circuit of the starting wire through the electro-magnet, 37, through plate, 30, along the lever, 19, and through the contact stud 18, and also through 21 and 24, to the earth wire, 24. The weight, 17, then falls into contact with the contact spring, 15, of the line wire, but cannot go further owing to the end of the lever, 19, passing across the slot. The current then passes along the line wire to 5 (fig. 2), breaks the circuit of the starting wire, and rings the bell, also making one dash in the Morse recorder. The attendant then throws his telephone and transmitter into circuit in the place of the Morse recorder.

When the telephone, 20, is replaced, the lever is moved out of contact with the earth connection, and the weight, 17, is lifted by means of the pin, 16, the latter having been resting on it. The apparatus is now in position for further signalling.

FIG.2



FOREIGN SECTIONS.

GOLFARELLI.

(*Italy.*)

The exhibits of MM. Golfarelli are as follows:—

Water Level Indicator.—This apparatus is of simple

construction, and both indicates and registers the rise and fall of the water in a reservoir.

Stenographic Apparatus.—This instrument is practically a pen, which records, by means of a combination of signs (instead of letters), any communication which is required to be written. There are two keys to the apparatus, by the depression of one or other, or both, of which, marks are recorded, which represent letters.

Dynamo-Electric Machine.—This machine differs from that of Paccinotti or Gramme in that the ring armature is induced both from the inside as well as the outside, so that nearly the whole of the wire on the ring is utilised for producing a current. The specimen of the machine which is shown at the Exhibition is very solidly constructed. Fig. 1 is a general view of the apparatus; fig. 2 is a section, showing the principle of the invention, which is self-evident.

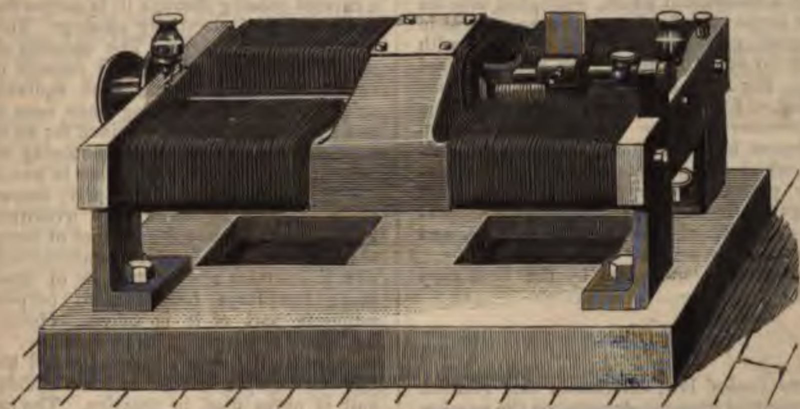


FIG. 1.

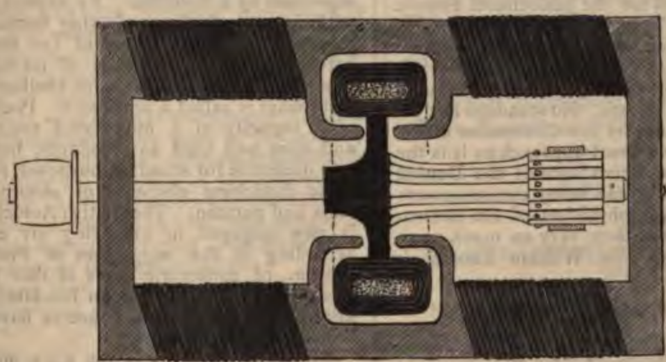


FIG. 2.

Small Electric Lamp.—The principle of this lamp is identical with that of Wilde, but the mechanism which keeps the carbons apart is somewhat different.

Besides the foregoing, MM. Golfarelli exhibit an *Electro-Magnetic Counter*, without gearing, and also an improved form of galvanometer, which is very sensitive in its action.

ON THE PRACTICAL MEASUREMENTS OF ELECTRICAL MAGNITUDES.

By W. H. PREECE, F.R.S., Electrician to the General Post Office, London.

(*Continued from page* 483.)

16. Having thus determined the unit of resistance, all the other units follow as a matter of course. The *Weber* is the name given to the practical unit of current. It contains 10^{-1} c.g.s. absolute units of current. No standard instrument has yet been constructed to measure currents in webers. That most generally employed and probably the best for the purpose, is the electro-dynamometer, for it has the advantage of being independent of magnetism, and, therefore, it can be fixed anywhere. The electro-dynamometer is based on the mutual force exerted between two currents. One coil of wire is freely suspended within another, and the current to be measured flows through each. In Siemens' form this force is opposed by a torsion spring, which brings an index back to zero. The intensity of the current is measured by the amount of torsion applied, indicated by a hand passing over a graduated circle. Professor Helmholtz has devised an electro-dynamometer, by which the current is actually weighed, that is,

its intensity is measured by the mass of matter required to counterpoise its force.

The tangent galvanometer of Pouillet is equally useful and very exact. When we know the horizontal component of the earth's magnetism for the position in which the observation is made and the dimensions of the galvanometer itself, we can calculate directly the strength of the current from the formula :—

$$C = \frac{K}{2\pi n} H \tan \theta$$

when K is the radius of the circle, n the number of turns, H the horizontal component, and θ the angle of deflection. The ordinary way is to determine the constant of the instrument by using a standard cell, whose internal resistance and electromotive force are known. We thus obtain a co-efficient which, multiplied into the tangent of the angle of deflection, gives the current in webers. Tangent galvanometers can be used with advantage only for small currents such as those used in telegraphy. For such currents as those used for electric lighting, or for the transmission of power, the electro-dynamometer is more practical and exact. M. Marcel Deprez has introduced a very useful galvanometer, in which a light induced magnet is maintained in the powerful magnetic field of a large horseshoe magnet. Its readings are directly proportional to the intensity of the current passing, and they give the current in webers.

Currents can also be measured by the heat they develop. The equation :—

$$H = \frac{C^2 R T}{J}$$

which expresses Joules' law, determines this relation and gives the result in gramme-degrees, or the number of grammes of water which would be raised 1° C. in temperature. One weber would raise 2405 grammes of water 1° C. in one second. This is a very useful method to determine the average value of alternate currents such as those used for the Jablochkoff electric light.

17. The *Volt* is the practical unit of electromotive force, and it contains 10^8 c.g.s. units of electromotive force. This may be due to no allowance being made for changes of temperature. No standard has yet been constructed of this unit by the Committee of the British Association. The nearest approach to it is the Daniell cell, but the electromotive force of the Daniell cell varies very much. A great many measurements have been made by different physicists of the electromotive force of this cell, but they vary as much as 10 per cent. from each other. Sir William Thomson's measurement, viz. :—

$$E = 1{\cdot}079 \times 10^8 \text{ c.g.s. units}$$

is a very good mean of all these observations, and it is that which is accepted in England. The standard cell used by the British Post-office is of this form, and has proved to be of great practical utility.*

Latimer Clark's zinc-mercury cell, the mercury in $Hg_2 SO_4$ and the zinc in $Zn SO_4$ is remarkably constant when freshly made, but it has not stood the test of practice. Its electromotive force is 1·457 volts at 15·5° C.

* This standard cell is peculiar in this respect, that while it is charged with the purest chemicals it has two idle cells, the one filled with a solution of sulphate of copper and the other with water, in the first of which the copper plate and porous pot are kept, and in the second of which the zinc plate is placed. The central cell, which is only used when wanted for observation, has sulphate of zinc in it. It is wonderful how month after month this cell maintains its constancy. For use the plates are removed from the idle cells into the active one.

It is unfortunate that we have not yet established a standard equivalent to a volt. This is a desideratum that remains to be obtained, and one of the most important duties that could be discharged by the Congress.

18. The unit of quantity is but very little used for practical purposes. It is derived from Faraday's law, which is expressed by the formula :—

$$Q = Ct.$$

and which implies that unit quantity is conveyed by unit current in unit time. It has not yet received a name, and it does not enter into much consideration in electro-magnetic measurement, for it is practically contained in the weber.* In electro-chemical phenomena, however, it is of great consequence. The weight of an electrolytic body, decomposed in a given time by a current passing through it, is proportional exactly to the quantity of electricity passing. This is true, even to the atomic weight. The quantity of a substance, which is decomposed by unit current in unit time, is called the "electro-chemical equivalent" of that substance, and this having once been determined for one substance can be determined for all electrolytes, for it is proportional to their combining numbers. It is for water 0·00092, or one weber in one second, that is, one unit of quantity (one ampère) decomposes 0·00092 of a gramme of water into 0·000102 grammes of hydrogen, and ·000318 grammes of oxygen.†

19. The "farad" is the practical unit of capacity, and it contains 10^{-9} c.g.s. units of capacity. This is much too large for practical purposes, and one millionth part of it is taken. Hence one microfarad = 10^{-15} c.g.s. units of capacity. It would have been better if the term "farad" had been applied to this submultiple instead of to the unit itself, for the unit is never used in practice. The capacity of any conductor is measured by the quantity of electricity it will contain when charged to unit electromotive force. A Leyden jar is a type of every system capable of retaining a charge of electricity. It involves two conductors separated by a dielectric. Its capacity varies directly with the area of the conducting surfaces opposed and inversely as the thickness of the insulating medium between them. Two sheets of tin-foil separated by thin paraffined paper or mica shellaced or paraffined, form what is called a *condenser*. Practical condensers of a capacity of $\frac{1}{3}$ microfarad are made of tin-foil and mica and used as standards, but air is the only safe dielectric for standard purposes, for it is free from those disturbing elements of absorption that vitiate mica and paraffin. The British Association Committee is now engaged in preparing air condensers made according to the suggestion of Professor Fleeming Jenkin, of concentric tubes of thin brass. They are measured by reference to an insulated sphere which is known, in an unlimited space to have a capacity that is measured by its radius.

20. *Work.* The *erg* is the c.g.s. unit of work. It is the work done by a dyne through a centimetre, but it is so small that it is magnified a million times for practical purposes and called a *megerg* = 10^6 ergs.

Since the work done by any current per second is

* In fact the name "Weber" was intended originally to have been applied to unit quantity, but custom—that powerful inventor of new terms—has transferred it to current, for which a name was more wanted, and to which it is betted suited—"webers per second" was too long to remain in every day use in this age of progress.

† Weber determined that one weber decomposes one gramme of water in 2 hours 57¾ minutes. Dr. G. Johnstone Stoney (B. A. 1874), calculated from the supposed dimensions of molecules as determined by Loschmidt, Sir William Thomson and himself, that it required 10^{-20} ampères to decompose each molecule of water, and he proposed this magnitude as a natural physical quantity that deserved to be taken as a new fundamental unit.

obtained in ergs by the product of the current into the electromotive force producing it, or :—

$$W = C\,E.$$

H. P. or the horse-power condensed is found by dividing C E by 746, or

$$\frac{C\,E}{746} = \text{H.P.}$$

The gramme degree $= 42 \times 10^6$ ergs $= 42$ megergs.
The pound degree $= 1{\cdot}91 \times 10^{10}$ ergs $= 19100$ megergs.

This unit of work is of vast importance in all questions relating to the economy of the electric light.

21. *Conclusion.* The physician's examination of the body of his patient by observation of the tongue, the pulse, the skin, and the temperature, is but tentative compared with the accuracy with which the physicist can examine the electrical condition of his apparatus and his inert bodies. The mental eye of the electrician can scan "the deep unfathomed caves of ocean." His theoretical insight can probe the impenetrable, it can open to the light of day the invisible portions of his little world.

It is impossible to exaggerate the benefit that the dynamical system of exact measurement has introduced into electrical engineering. It has been its "eureka." It has made submarine telegraphy practically and commercially possible, for it enables the engineer to calculate with wonderful accuracy the position of the smallest flaw in the longest cable, and in the deepest and roughest sea to direct his ship with unerring precision to the locality of a break. It has led to the improvement of the quality of the wire used so as to insure increased speed and greater economy of working. It has determined the quality of the materials used for insulating purposes, and while it has maintained their efficiency it has led to great economy in construction.

In England no wire either overland, underground, or submarine is allowed to be accepted without careful inspection and measurement of its resistance and capacity. In the British Post-office every apparatus is carefully measured, and each one being specified, it is rejected if it fails to comply with the electrical as well as the mechanical requirements of the specification. The improvement in working effected thereby is immense. Failure of apparatus, which was the most common of faults in working, has become now the least common. The condition of the wires of the country from day to day is obtained, and accurate inspection is maintained by noting the variation of the currents received at the end of the circuits. Instruments of research have become fine tools and true gauges in the hands of the physicists. Rough qualitative measurements have become truly quantitative.

Its benefits have been equally great in the other practical applications of electricity to useful purposes, especially in electric lighting and in the transmission of power. Indeed, without its aid it would have been impossible to have obtained that proper relation between power expended and useful effect produced, which alone has rendered this magnificent application of one of the great forces of nature to the wants of mankind practicable and profitable.

[P.S.—The above paper was translated for me into French by my friend, M. Alfred Niaudet, and printed by the proprietors of the Paris *L'Electricien** for distribution among the members of the International Electrical Congress assembled in Paris to discuss, among many others, the all-important question of units, with a view of establishing a system of electrical measures for international adoption.

The propositions enumerated above were not all adopted, but at the sitting of September 22nd, the following resolutions were unanimously agreed to :—

1. For electrical measurements, the fundamental units, the centimetre (for length), the gramme (for mass), and the second (for time), are adopted.

2. The ohm and the volt (for practical measures of resistance and of electromotive force or potential) are to keep their existing definitions, 10^9 for the ohm, and 10^8 for the volt.

3. The ohm is to be represented by a column of mercury of a square millimetre section at the temperature of zero Centigrade.

4. An international commission is to be appointed to determine, for practical purposes, by fresh experiments, the length of a column of mercury of a square millimetre section which is to represent the ohm.

5. The current produced by a Volt through an Ohm is to be called an Ampère.

6. The quantity of electricity given by an Ampère in a second is to be called a Coulomb.

7. The capacity defined by the condition that a Coulomb charges it to the potential of a Volt is to be called a Farad.

The international system of electrical units (Paris, 1881) is therefore represented in the following table :—

Symbol.	Electrical Quantities.	Nomenclature.	C. G. S. Units.
R	Resistance	Ohm ...	10^{9}_{8}
E	Electromotive Force	Volt... ...	10
K	Capacity	Farad ...	10^{-9}
Q	Quantity	Coulomb	10-1
I	Intensity of Current	Ampère ...	10-1

The conclusion is most satisfactory to all concerned, and it is hoped that this system will be speedily and universally adopted. The honoured name of Weber was replaced by Ampère because it was already in use in Germany to indicate a different value, and it was feared that its retention would lead to inconvenience.— W. H. P., Nov. 30, 1881.]

* It originally appeared in this excellent paper.

Correspondence.

TELEGRAPHING WITHOUT CONDUCTING WIRES, Etc.

To the Editor of The Telegraphic Journal.

Sir,—In the issues of the Telegraphic Journal and Electrical Review, dated the 15th January, 1878, and 1st March, 1879, it is stated that Professor Loomis, the distinguished American astronomer, has succeeded in telegraphing a distance of about 20 miles from the peaks of the mountains of West Virginia with the aid of *aerial currents*, and *without any conducting wires between the two stations*. As this subject is exceedingly useful and interesting to all electricians in all parts of the world, would you very kindly favour us, through the medium of your highly scientific and widely-circulated journal, with the exact details of the Professor's experiments, and state if any further advancement on the subject has been attained since the publication in the journal, as above-mentioned. I take this opportunity of asking you if there has been any *new edition* of Latimer-Clark and Sabine's "Electrical Tables

and Formulæ," since the one published either in 1870 or 1871? The subject of electrical measurement is getting so elaborate and advancing with such rapid strides, that I believe the time has approached for a *new edition, complete up to date*, being put in the hands of all telegraph engineers, electricians, and operators, and we hope the subject will attract the attention of some of our able electricians and engineers.

Could you kindly let us know if any pamphlet or notes on lectures have been published by Professor Ayrton of his lectures to the students in the City and Guilds Institute?

Simla, Yours truly,
Nov. 6th, 1881. INDIAN TELEGRAPH.

[We believe that no detailed description of Professor Loomis' experiments has been published, nor, as far as we know, has the subject been pursued further. No second edition of Clark and Sabine's "Electrical Tables and Formulæ," has been published, and we are not aware that the authors have any intention of compiling one. The subject of electrical measurement has been exhaustively treated by Mr. H. R. Kempe in the second edition of his work on "Electrical Testing," published by Messrs. Spon. This latter work is undoubtedly the most complete book on the subject yet issued. No pamphlet has yet been published by Professor Ayrton of his lectures before the City and Guilds Institute.—Edit. Tel. Jour.]

LIGHTNING CONDUCTORS.

To the Editor of The Telegraphic Journal.

Sir,—I wish to protect a square house which has nine chimneys, all of equal height, from lightning by means of two iron rods, 3 ft. above two of the *centre* chimneys, connected by a galvanised iron wire conductor with the iron water pipe which supplies the house.

Will you kindly tell me if this protection will be sufficient, and whether two chimneys at the angles of the house would not be better than central ones, which I prefer owing to their being almost hidden from view by the parapet which surrounds the building? "B."

[Two rods are hardly sufficient to completely protect a building of the kind you describe; every chimney, especially if it be in use, is a source of danger. It would be decidedly preferable to place the two rods at the angles of the house rather than in the middle, but in any case the points of the rods should project a foot or two above the chimneys. The best plan would be to have a rod to each chimney, all connected to the lead of the roof, and also to the iron water pipe, the rods in this case need not project more than a few inches above the chimneys. If your iron water pipe is of a large size, it would probably be sufficient to act as the main conductor to the ground, but it would be advisable to have also two independent main conductors, one at each end of the house, carried down to the ground, and there either connected to earth plates in the moist earth, or to the water mains. It is essential that the conductors be of stout iron, if of the latter metal; the best conductors are those of copper rope, ½-inch in diameter, such as are supplied by Messrs. R. S. Newall & Co.—Ed. Tel. Jour.]

Notes.

The Paris Electrical Exhibition.—M. Cochéry intends to spend the surplus of the Electrical Exhibition, which is said to exceed £16,000, in establishing a research laboratory for electricity.

The Electric Light at the Cattle Show.—This exhibition was lit by the Brush system.

The Edison Electric Light in New York.—The Edison Electric Light Company has begun to lay the wires for the illumination of a district in New York, bounded by Spruce Street on the north and Nassau Street on the west, the whole, when completed, containing fourteen miles of conductors. These are laid insulated in pipes which are cemented into boxes in which there is an expansion joint for the conductors, consisting of a copper loop. The conductors are half round in section, 1 inch broad and ¼ inch thick, and are made of copper. The pipes and their contents are buried about two feet below the ground. The company (says *Chambers' Journal*) have already contracted to supply 1,100 consumers with 9,000 16-candle and 4,000 8-candle lights. Wires have been laid to 980 buildings, including one printing office which is to be supplied with 550 lights and one with 600 lights. The company charge according to the amount of electricity consumed as registered by a metre. The lamps (which last about eight months) are supplied free of charge. Besides electric lamps, the current is employed to drive 214 pumps raising water to upper storeys, 2,309 sewing machines, hoists, elevators, &c. About 1,433 horse-power is consumed in supplying the current.

The Electric Light at Barnsley.—Barnsley was on the 2nd inst. lighted with the electric light for the first time. The corporation have differed with the gas company. The latter will not concede the reductions which the corporation think should be made, and the council are trying the electric light as an experiment. If it answers it will be adopted. The light now used is that of the Brush system. Several business establishments also introduced the light in their shops. There are eight public lights.

The Electric Light in Paris.—The Paris Municipal Commission has resolved to illuminate successively the Council Hall with five different electric lights, to determine the price of each, and make a choice amongst them. These five have been selected out of all the systems exhibited. The Swan and Brush systems are two of those selected for the competition.

Photometric Standards.—The committee on photometric standards have presented their report to the Board of Trade. They find that the method of taking the average of three consecutive candle determinations to indicate the illuminating power of coal gas does not yield satisfactory results. Not only do sperm candles exhibit intrinsic differences which unfit them for use as a standard, but the method of using them permits of variations which introduce serious errors into this mode of testing the illuminating power of coal gas. After a series of experiments with various photometric standards submitted to them, the committee recommend the adoption of Mr. A. G. Vernon Harcourt's air-gas flame, in which the combustible gas is a definite mixture, prepared by the operator, of air and the vapour of light petroleum. The gas is burnt at a definite rate from a ¼-in. orifice in a brass burner, and the height of the flame is adjusted to 2½ in. At the same time they recommend that in official documents the quality of light furnished by coal gas, as shown by Mr. Harcourt's lamp, should be expressed as heretofore in standard candles.—*Engineer*.

Telegraphic Communication Between Dover and the Continent.—Since the recent heavy gale, all direct communication between Dover and the Continent by the Submarine Telegraph Company's Boulogne

and Calais cables has been interrupted, both cables having been broken. The Boulogne cable runs between Cape Grisnez and Abbotscliff, near Dover. It is a six-wire cable, and was first laid in 1859. In 1875 the portion running between the Varne and the Cape was renewed, owing to the frequent damage caused by the roughness of the ground between those places, but since then until the present breakdown the cable has given little or no trouble. The Calais cable runs between Sandgatte on the French coast, and the South Foreland, on the English coast. The tests at the South Foreland show that the Boulogne cable is disconnected about three miles and a quarter from the shore at Cape Grisnez, the Calais cable having been parted at between five and six miles off Sandgatte. Several of the land wires between Dover and the cable ends on the English coast were blown down by the force of the wind. The Company's repairing ship, the *Lady Carmichael*, shipped a large quantity of new cable, and proceeded to repair the damage, but on the 3rd inst. she returned to Dover Harbour, as owing to the heavy sea on the French coast the engineers were unable to find the cables, several grapnels being broken in dredging for them.

ELECTRIC RAILWAYS.—Eisenach is to have an electric railway from the station to the castle of the Wartburgh, if the royal permission can be obtained. Mr. Siemens, of Messrs. Siemens and Halske, Berlin, is in America, and has been in consultation with Messrs. Gould, Sage, and Field, regarding the adaptation of his electrical motor to the requirements of the New York Elevated Railways. Mr. Sage is reported as favourably impressed with Mr. Siemens' representations, and intimates that experiments with the electric motor may be undertaken.

EDINBURGH STREET TRAMWAYS COMPANY AND ELECTRO-MOTORS.—The shareholders of the Edinburgh Street Tramways Company at a special meeting held at Edinburgh, have decided to apply to Parliament for powers to use mechanical and electric motors on their tramway system.

THE FAURE BATTERY.—We understand that the success of the Faure storage battery has not turned out to be so great as was anticipated; it is found that the felt wears into holes and that metallic lead forms between the plates causing short circuits, and of course entirely destroying the efficiency of the cells.

STORAGE BATTERIES.—Mr. Edison is making experiments on batteries for the storage of electric energy.

THE GRAMME PATENTS.—The *Paris Bourse* states that the Gramme patents for the transmission of motive power by electricity have become the property of a company constituted with a capital of £400,000, under the auspices of the Société Internationale des Téléphones.

HONOURS TO A TELEGRAPH ENGINEER.—The *Telegrafista* of Rome for November announces that Mr. Alfred Egginton, representative in Italy of the Eastern Telegraph Company, has been nominated by his Majesty King Humbert, Chevalier of the order of the Crown of Italy.

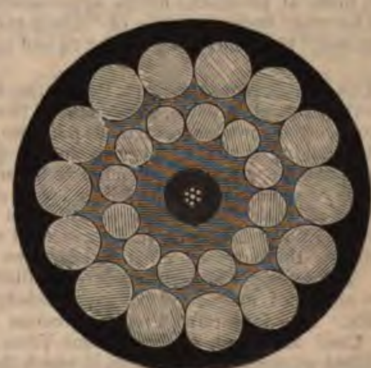
CENTRAL AND SOUTH AMERICAN TELEGRAPH COMPANY'S CABLES.—As implied in our last issue, we give a brief outline and sketches of the various types of cable now being manufactured at Silvertown for the above company's line. The conductor, which is the same for all the cable, consists of a strand of 7 copper wires (No. 22 B. W. G.), weighing 107 lbs. per nautical mile, and having a conductivity 96 per cent. that of pure copper. It is insulated with two coatings of gutta-percha, with alternate layers of Chatterton's compound, and weighs 140 lbs. per N. M. The core

MAIN.

for the main cable is served with a sufficient quantity of jute yarn, and then sheathed with 15 No. 13 B. W. G. Homo iron wire, galvanised. The outside serving consists of two compounded tapes, laid on in an opposite direction. The core for the intermediate cable is similarly served, and then sheathed with 12

INTERMEDIATE.

No. 6 B. W. G. best best galvanised iron wire. Outside serving similar to main cable. The shore end consists of the intermediate cable without taping, and sheathed with 14 No. 1 B. W. G. best best galvanised iron wires. The insulation resistance after one minute's electrification must not be under 250 megohms per N. M., and the guarantee after laying the cable is



SHORE END.

for 30 days, when the insulation resistance must not be less than 225 megohms per N. M. reduced to 75° Fahr. by the co-efficient for G. P. in Clark and Sabine's

"Tables and Formulæ." The breaking strain of main cable is 5½ tons, its weight per N. M. is 1·6 tons, that of the intermediate type 4·31 tons, and the shore end 14·64 tons. The intermediate type when submerged is to overlap the 100 fathom line, and the main cable is to be laid in as nearly as is practicable 300 fathoms, as is the case with the West Coast of America Telegraph Company's cables.

ERICHSEN (AS REPRESENTATIVE OF THE LONDON AGENCY OF THE GREAT NORTHERN TELEGRAPH COMPANY OF COPENHAGEN) *v.* LAST.—This case, adjourned from the 5th inst., was resumed on the morning of the 6th. It was an appeal by Mr. Erichsen from an order made by Justices Lindley, Williams, and Mathew on a case stated by the Income Tax Commissioners for the City of London, and which came on for hearing before their lordships sitting on the revenue side of the Queen's Bench Division. The substantial question raised by the case was whether the company had been properly assessed by the Commissioners at a sum of £40,000 for the financial year ending April, 1877, in respect to the profits of their business as carried on in the United Kingdom, with which the company's chief seat at Copenhagen is connected by three marine cables, the one at Peterhead in Scotland, and the two others at Newbiggin, near Newcastle. For the company it was contended that as no profits were made by them by the transmission of messages by their land lines in the United Kingdom, they were not liable to be assessed under Schedule D of the income tax, and in the alternative that if liable to be assessed at all it could only be in respect of the profits from the transmission of messages over these three cable lines. On the other hand, it was contended by the surveyor of taxes that as the company had an agency in this country which received payment direct from the senders of messages at the rate of £70,000, they were liable to the tax on the total profits earned in this country from the transmission of messages. Sir Hardinge Giffard, Q.C., and Mr. Bremner argued the case for the appellant company. Their lordships, without calling on the Attorney-General, the Solicitor-General, and Mr. Dicey, who appeared for the Crown, affirmed the decision of the Court below, and dismissed the appeal, with costs.

CLERKS AND TELEGRAPH LEARNERS AT PROVINCIAL OFFICES.—The Postmaster-General announces that consequent on the amalgamation of the postal and telegraph force at provincial offices, appointments will in future be made under the title of "Clerk and Telegraph Learner," the limits of age being 14 and 25.

THE USE OF ELECTRICITY FOR PURIFYING PORCELAIN PASTE.—Porcelain paste, on account of the origin of the kaolin, often contains ferruginous particles, which give it after baking a slight yellowish tint, or sprinkle it over with small spots when intended to be perfectly white. Every one knows that the finished ware may, in consequence of such defects, lose as much as 50 per cent. of their value. Hence a really practical method for removing these traces of iron has been much desired. The attempts hitherto made of utilising the attractive action of magnets have given chiefly negative results. Two important French porcelain works, that of Creil and that of Mehun-sur-Yévre, have recently fitted up powerful apparatus, in which the electricity instead of being supplied by feeble batteries, is obtained by means of a small Gramme machine, driven by a steam-engine. The apparatus, a model of which was shown at the exhibition, is composed of a powerful horizontal electro-magnet, the poles of which are placed *at a small distance* from each other. Between these poles is fixed a box, which is thus in a powerful magnetic field, provided that the exciting current is sufficient. The very liquid paste enters at the upper part of this box, and is turned laterally so as to play along the polar sides of the box, and escapes finally by a pipe which leads it to the settling-tanks. It is readily seen that the particles of iron remain fixed to the polar sides of the box. To clean the apparatus the magnetic action is suppressed and a powerful stream of water allowed to traverse the box. This is performed twice daily. One such apparatus suffices for 500 to 600 kilos. of paste daily. About 1 gramme of ferruginous matter is thus extracted from every 12 kilos. of paste.—*Annales Industrielles.*

Proceedings of Societies.

THE PHYSICAL SOCIETY.

AT an ordinary general meeting of this Society, held November 26th, Professor W. G. ADAMS in the chair, Mr. C. VERNON BOYS read a paper "On Integrating Apparatus." After referring to his original "cart" machine for integrating, described at a former meeting of the Society, he showed how he had been led to construct the new machine exhibited, in which a cylinder is caused to reciprocate longitudinally in contact with a disc, and give the integral by its rotation. Integrators were of three kinds, 1° radius machines, 2° cosine machines, 3° tangent machines. Sliding friction and inertia render the first two kinds unsuitable, where there are delicate forces or rapid variations in the function to be integrated. Tangent machines depend on pure rolling, and the inertia and friction is inappreciable, they are therefore more practical than the other sort. It is to this class that Mr. Boys' machines belong. The author then described a theoretical tangent integrator depending on the mutual rolling of two rings, and showed how the steering of a bicycle or wheelbarrow could be applied to integrate directly with a cylinder, either the quotient or product of two functions. If the tangent wheel is turned through a right angle at starting the machine will integrate a reciprocal, or it can be made to integrate functions by an inverse process. If instead of a cylinder some other surface of revolution is employed as an integrating surface, then special integrations can be effected. He showed a polar planimeter in which the integrating surface is a sphere.

A special use of these integrators is for finding the total work done by a fluid pressure reciprocating engine. The difference of pressure on the two sides of the piston determines the tangent of the inclination of the tangent-wheel which runs on the integrating cylinder, while the motion of the latter is made to keep time with that of the piston. In this case the number of revolutions of the cylinder measures the total amount of work done by the engine. The disc cylinder integrator may also be applied to find the total amount of work transmitted by shafting or belting from one part of a factory to another.

An electric current meter may be made by giving inclination to the disc which is for this purpose made exceedingly small and delicate, by means of a heavy magnetic needle deflected by the current. This, like Edison's, is a direction meter, but a meter in which no regard is paid to the direction of the current can be made, by help of an iron armature of such a shape that the force with which it is attracted to fill the space between the holes of an electro-magnet is inversely as

its displacement. Then by resisting this motion by a spring or a pendulum the movement is proportional to the current, and a tangent wheel actuated by this movement causes the reciprocating cylinder on which it runs to integrate the current strength. Mr. Boys exhibited two such electric energy meters, that is, machines which integrate the product of the current strength by the difference of potential between two points with respect to time. In these the main current is made to pass through a pair of concentric solenoids, and in the annular space between these is hung a solenoid, the upper half of which is wound in the opposite direction to the lower half. By the use of what Mr. Boys calls "induction traps" of iron, the magnetic force is confined to a small portion of the suspended solenoid, and by this means the force is independent of the position. The solenoid is hung to one end of a beam and its motion is resisted by a pendulum weight, by which the energy meters may be regulated like clocks to give standard measure. The beam carries the tangent wheels, and the rotation of the cylinder gives the energy expended in foot-pounds or other measure. The use of an equal number of turns in opposite directions on the movable solenoid causes the instrument to be uninfluenced by external magnetic forces. Mr. Boys showed on the screen an image of an electric arc, and by its side was a spot of light whose position indicated the energy, and showed every flicker of the light and fluctuation of current in the arc. He showed on the screen that if the poles are brought too near, the energy expended is less, though the current is stronger, and that if the poles are too far apart, though the electromotive force is greater, the energy is less; so that the apparatus may be made to find the distance at which the greatest energy, and so the greatest heat and light, may be produced.

At the conclusion of the paper, Professor W. G. Adams and Professor G. C. Foster could not refrain from expressing their high admiration of the ingenious and able manner in which Mr. Boys had developed the subject.

THE SOCIETY OF ARTS.

(*Continued from page* 495.)

Grove's Gas Battery.

In 1842, Sir William (then Professor) Grove described the well-known gas battery, which was indeed nothing else than a reversible oxygen and hydrogen battery, in which work had first to be done to produce chemical decomposition.

The rationale of the gas battery is simple enough, provided it be once understood that platinum possesses a power almost unique amongst the metals, of absorbing upon its surface both oxygen and hydrogen gas.

Planté's Secondary Battery.

M. Gaston Planté, to whom, more than to any other experimenter, the real advances in the practical construction of storage batteries are due, very carefully reexamined the whole question of the polarisation of electrodes, using different metals as electrodes, and different liquids as electrolytes, and found that the greatest effective polarisation was produced when dilute sulphuric acid was electrolysed between electrodes of lead. The Planté cell is shown by fig. 1.

The electromotive force developed in a fully charged Planté cell may be as much as 2·38 or even 2·7 volts. A Bunsen battery of small size and considerable internal resistance will take some hours to charge a cell fully, while a dynamo-electric machine may fully charge it in half-an-hour; but the rate of discharge will be alike in each case. M. Planté states that voltametric measurements show that of the whole current 88 to 89 per cent. is given back by the cell. According to M. Géraldy

Fig. 1.

Planté cell containing 1·445 kilogrammes of lead can store 4·983 kilogrammètres of energy, being at the rate of 3·45 kilogrammètres per kilogramme, or 11·329 foot-pounds per pound.

There appears to be an amount of ignorance in the scientific world that is simply inexplicable with respect to the magnificent researches of Planté, and the variety of useful applications to which his accumulator had been put before even the fame of more recent inventions had been noised abroad—before they had even been made at all.

Faure's Accumulator.

In 1880 M. Camille Faure conceived the idea of constructing a secondary battery, in which, though the tedious process of "formation" by Planté's process is modified and shortened, the ultimate result is the same, namely, to produce upon lead plates, immersed in dilute sulphuric acid, a coating of peroxide of lead, that can readily be reduced to the loosely crystalline metallic condition. This M. Faure accomplishes by the device of giving to his leaden plates a preliminary

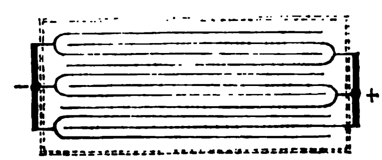


Fig. 2.

coating of red lead (minium), made up into a paste with water or dilute acid, and painted upon the surface. At first he adopted the spiral form of cell, the two plates being separated by felt or leather. More recently the rectangular form has been reverted to. The present mode of construction is as follows:—Eleven sheets of lead of such thickness as to weigh

about 2 lbs. to the square foot are cut to the size of 12 inches by 10 inches, an ear-piece being left at one corner. Or six sheets are taken, five of them being twice the above size, and folded double in the way shown in fig. 2. These are painted thickly with red lead on

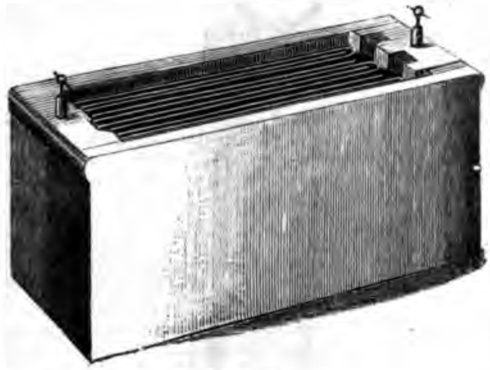


Fig. 3.

both sides, and against each side is pressed a piece of felt, the face of which is also thickly coated with red lead; there being about 17 lbs. of lead and 25 lbs. of red lead altogether. These eleven sheets are placed side by side in a water-tight case, alternate sheets being connected together by the projecting flaps. The general aspect of the cell is shown by fig. 3. The cell is filled up with dilute acid; the total weight being about 50 lbs.

When thus prepared, the cells are "formed" by a process of charging by means of the current of a dynamo-electric machine, the current being sent through them for something like a hundred hours before they are ready for use. The red lead is reduced gradually on one side to the metallic state, and on the other assumes the condition of peroxide; but the cell does not attain its best condition for some weeks. As it is important that the electromotive force of the charging current should not much exceed that of the cells (2·38 volts), it is usual to charge a number of cells in series. The internal resistance of such cells is stated as being less than ·01 ohm. The advantage of this system of construction is not confined to the saving in time of formation: there is the further advantage of thus obtaining a much thicker film of the working substance than in the Planté accumulator; though with the difference that the deposit of peroxide is not so regular in its structure. According to Sir William Thomson, a single cell of the spiral form weighing 75 kilogrammes (165 lbs.) can store 2,000,000 foot-pounds of energy, or one horse-power for one hour. Their action is more economical, however, when the charge is not drawn upon at this rapid rate. Economy in working is found to accompany slow and regular discharge. Five or six hours is a more economical time for discharge, and then the waste is believed not to amount to more than ten per cent. According to Reynier, a Faure cell, containing 56 kilogrammes of lead, can store 210,000 killogrammètres of electro-chemical energy; or at the rate of 3·75 kilogrammètres per kilogramme of lead, or 12·85 foot-pounds per pound of lead. According to M. Géraldy, the figure is slightly less, being only 3·280 kilogrammètres per kilogramme, or 10·760 foot-pounds per pound. Sir William Thomson's data yield the much higher figure of over 30,000 foot-pounds per pound of lead.

De Méritens' Accumulator.

Another modification of the Planté accumulator has been devised by M. de Méritens. In this cell the plates of lead are made up of thin laminæ, folded one upon another like the leaves of a book, or more strictly, like the laths of a venetian blind; the whole being soldered to a stouter framework of lead. The object of this arrangement is to secure a greater amount of effective surface. This accumulator has been highly spoken of, and showed admirable results at the late Electrical Exhibition in Paris. No examples have yet been brought to England, and I am not aware of any exact measurements having been made of their power or capacity.

Other Modifications.

In investigating the properties of secondary batteries, I have tried a number of modifications of the Planté accumulator, with varying success. I have found that almost any oxide or hydrate of lead will answer instead of red lead for the purpose of providing, as in the Faure cell, a material to be converted by a process of formation into the peroxide of lead. Litharge answers well if sufficiently finely divided before being painted on. White lead will even answer, but not so well. Litharge mixed with a small proportion of binoxide of manganese works well. The formation is rapid, but at first the electromotive force is not so high as in the Planté cell. It rises, however, as the process of formation proceeds. The binoxide of manganese is not (see table, page 492, December 1st), so strongly electro-negative a substance as the peroxide of lead. Its presence in the final state would lessen the electromotive force. But happily the manganese gradually dissolves into the acid when its function as an agent to assist the lead in peroxidising is fulfilled and by changing the acid a few times it is finally eliminated. The most satisfactory cells I have yet tried were made by painting the lead plates with a coat of the brown peroxide itself, which is obtainable in commerce, though its cost is about four times that of red lead or of litharge. I find this process by far the most expeditious for making up cells; as indeed might be expected, since it is obviously a stage towards simplification to put on to the lead plates a coating of the very substance which we desire ultimately to produce there. Examination of the plates of a cell in which the process of formation has only just begun, shows that the lead surface must itself be peroxidised and bitten into before the useful action extends to the contiguous portions of oxide or peroxide painted over it, and in some stages a yellow suboxide, probably essentially litharge, appears to be produced as an intermediate product of the reduction of the oxide at the cathode. Of this intermediate yellow product, however, I can find no trace in well-formed cells. As the reduction and peroxidation of the coating only begins where peroxidation of the leaden sheet has begun, the relation of density to maximum polarisation, pointed out in an earlier paragraph of my paper, becomes of extreme importance. Plenty of current, and yet an electromotive force only just exceeding the maximum electromotive force of the cell is the rule for charging in the early stages of formation.

Comparison of Planté's and Faure's Accumulators.

No very reliable comparison between the accumulators of Planté and those of Faure, or of de Méritens, have yet been made. Seeing that in each of these, when completely formed, the materials are the same—namely, lead and peroxide of lead immersed in dilute sulphuric acid—the maximum electromotive force must be eventually the same in each. The resistance of a

cell is simply a question of size and shape. The relative strength of current actually furnished by these cells should therefore merely vary with their dimensions. The presence however, of the felt, and its coatings of red lead, introduces resistance into the Faure cell, and as some recent determinations of M. Achard show, a Planté cell will heat a greater length of platinum wire, and do its work three times as quickly as a Faure cell, whose surface is of the same amount. One would also expect *a priori* that the layers of peroxide, formed upon the electrode by the working of the current itself, should be more regular, and yield currents with greater regularity, than the artificial and more rapidly-formed layers made by painting red lead upon the surface. On the other hand, M. Faure points out that, taking cells of equal size, a larger proportion of the weight in his cell consists of the working substance. The weight of red lead placed in his cells being, for equal amounts of surface, about 26 times as much as the weight of peroxide produced by a "formation" during two years on the plates of a Planté cell of equal size. If this be so, it would imply that, though its resistance might be greater, and its rate of working slower than the Planté cell, the Faure cell would accumulate twenty-six times as much energy in an equal space. These figures require yet to be confirmed, and they are hardly borne out by the statistics of M. Reynier. The Faure cell will do what the Planté cell will not, take in a greater charge, because it has a greater thickness of the working material, and it gives up its charge less rapidly. The Planté cell will do what the Faure cell of equal weight or surface cannot do, namely, produce rapid discharges in currents of greater volume; a property invaluable for the purpose of some of the applications already named.

Application to Electric Lighting by Incandescence.

Faure's cells have already done good work in providing an efficient means of working incandescent lamps, such as those of Swan and Maxim, for domestic purposes. I have the pleasure of showing you to-night the result of passing through a number of Maxim lamps, the current generated by forty of Faure's accumulators. Here are also some of the incandescent lamps of Swan, and of Edison, lit up by the same means. I have to thank the representatives of the various companies for the courtesy that has put at my disposal these means of illustrating my discourse.

Maximum Temperature Attainable by a Cell.

In connection with the subject of obtaining a high temperature by means of a cell, it may not be out of place to point out that the very high electromotive force of these accumulators (about 2·2 volts), exceeding that of any single cell of any other kind, carries with it the possibility of obtaining with such a cell a higher temperature than with any cell of lower electromotive force. This discovery is due to Lorenz, of Copenhagen, who in a very remarkable paper published (in "Wiedemann's Annalen") in August last, upon the relation between the conducting power of metals for heat and for electricity, has shown that the highest possible temperature which a cell can raise any part of its circuit is proportional to its electromotive force. The highest point to which a Daniell's cell, however large, can raise a conductor is, according to Lorenz, 3,327° above the zero of the Centigrade scale. The limiting temperature for a Planté or a Faure cell is 6,927°.

Application to Perfection of the Telephone.

Another application of the secondary batteries which has occured to me, and which on a small scale, I have tried with success, is in connection with telephone transmitters. I propose to increase the power of a transmitter, by employing a multiple microphone, so arranged that a fairly strong current shall pass through each point of contact, and that the current through each contact shall be independent of that through the rest. I therefore arrange all the individual microphones in parallel arc, in the line circuit, but provide each with its own battery. A hundred microphones thus united, and simultaneously acted upon by the voice, will each add their own quantum to the total effect in the circuit; and the result will be loud and distinct speech. But a hundred microphones so arranged, each with its own battery, implies two or three hundred cells. Here the secondary cell comes in with great advantage. I propose to use very small storage cells, each consisting of two small leaden plates, or wires, dipping into diluted sulphuric acid, and properly "formed." Two such cells may be connected with each microphone, and the whole, being already arranged in parallel arc in the circuit, can be kept charged by merely placing across the circuit six Daniell's cells, to be switched off when the transmitter is to be used, and switched on again when the transmitter is no longer required. As yet only a small and rough model of this "secondary circuit transmitter" has been made; but it is extremely satisfactory in its action, and promises to be the first of a useful and important application.

Application to Utilisation of Wind and Water-power.

And, lastly, though by far the most important of all the innumerable possibilities opened out by the storage battery, is its application to the problem of utilising and transmitting the energy derived from wind or water-power. The accumulator will probably play an important part also in the distribution as well as in the storage of power transmitted from a distance, and thus become the ally of the dynamo-electric machine. It is certain that we cannot, with our diminishing coal-fields, long afford to neglect these other sources of natural power. A tenth part of the tidal energy in the channel of the Severn would light every city and turn every loom and spindle and axle in Great Britain. But the power would have to be not only transformed and transmitted, but stored to be available for such ends. Accumulators are therefore a necessary feature in any scheme to utilise the intermittent forces of the tides. Whether the present form will prove adequate to the purpose, the future must decide. There are, as I have sufficiently shown, immense possibilities in store. Electrical railways and electrical tramways are now existing facts. Many months will not elapse—or it will be an eternal disgrace to the first city in the world—before the fetid and poisonous atmosphere of the Metropolitan Railway is replaced by a pleasant and salubrious air, rich in fragrant ozone; and the like revolution will not be long delayed in many quarters where reform is far less imperative. In all these changes the accumulator will have its part to play. A reverse of electrical energy stored till wanted ser
will be a necessary part of all systems for electric distribution, whether for the purpose of lighting, or for motive power.

In conclusion, I would point out how the invention of the accumulator for storing the energy of electric currents has arisen out of the study of an obscure and unpromising detail in the science of electricity—the phenomenon of so-called "polarisation." Regarded by most experimenters merely as a trivial but disturbing fact in the construction of voltaic batteries, to be put down or got rid of by whatever means, it has been developed, and, mainly by the long and patient

researches of one man—M. Gaston Planté—been turned into one of the most fertile and promising features in the development of the science.

[For further information on the subject of the Planté battery, and on a subject closely allied to the secondary battery question, viz., "polarisation," we beg to refer our readers to articles published in the numbers of the Journal for Dec. 15th, 1872; June 15th, 1873; and Dec. 1st, 1875.—Edit. Tel. Jour.]

New Patents—1881.

5185. "Electric lamps." E. G. Brewer. (Communicated by A. G. Waterhouse.) Dated November 28.

5198. "Production, conservation, and regulation of electric currents." C. H. W. Biggs and W. W. Beaumont. Dated November 28.

5216. "Improvements in hydraulic motors, and in the application thereof to the production of electric light." J. E. Liardet and J. Donnithorne. Dated November 29.

5221. "Apparatus to be controlled and operated by electricity for stopping trains and giving signals on railways." W. R. Lake. (Communicated by W. C. Schaffer.) *Complete.* Dated November 29.

5226. "Improved means of joining or coupling branch to main conducting wires or cables for electrical purposes, and of insulating such joints." A. W. Brewtnall. Dated November 29.

5229. "Improvements in and relating to the utilisation of electricity for lighting or other purposes, and in apparatus therefor or to be used in connection therewith." W. R. Lake. (Communicated by J. S. Williams.) Dated November 30.

5233. "Improvements in and relating to the utilisation of electricity for lighting or other purposes, in apparatus therefor or connected therewith, and in means for producing or manufacturing such apparatus." W. R. Lake. (Communicated by J. S. Williams.) Dated November 30.

5261. "Construction of secondary batteries." H. E. Newton. (Communicated by E. Volckner.) Dated December 1.

5272. "Electric lamps." W. F. King and A. B. Brown. Dated December 2.

5286. "Improvements relating to the production of electric light in electric lamps, in the means for and methods of manufacture of the carbons and incandescing conductors for the same." A. R. Sennett. Dated December 3.

5295. "Improved mechanism for regulating the feed of electrodes in electric lamps." H. E. Newton. (Communicated by A. J. Gravier.) Dated December 3.

5303. "Construction of telephones." J. Burton. Dated December 5.

5309. "Preparation of materials to be employed for the purposes of electric insulation." J. A. Fleming. Dated December 5.

5316. "Apparatus for lighting railway and other carriages by electricity." R. Laybourne. Dated December 5.

5322. "Electric accumulators." J. Imray. (Communicated by J. Carpentier and Odo Pezzer.) Dated December 6.

5338. "Secondary batteries." D. G. Fitzgerald, C. H. W. Biggs, and W. W. Beaumont. Dated *December 6.*

5360. "An improvement in or connected with telephone transmitters." E. H. Johnson. Dated December 7.

5367. "An improved machine for covering or coating insulated electrical conductors or conducting wires with lead." W. R. Lake. (Communicated by H. S. Maxim.) Dated December 8.

5368. "An instrument or apparatus to be used as a photometer, actinometer, and sensitometer." J. D. Mucklow and J. B. Spurge. Dated December 8.

5385. "Improvements in telephones and in lightning arresters therefor and in other purposes." G. W. Foster. Dated December 9.

5396. "Electric lighting." C. F. and F. H. Varley. Dated December 9.

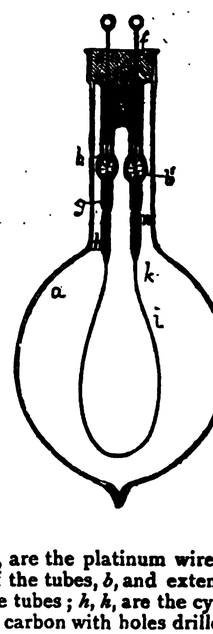
5400. "Electric light lamps or lanterns." J. Rowan. Dated December 9.

5407. "An improved manufacture of compounds for electrical insulation." W. Abbott and F. Field. Dated December 10.

5418. "Arrangements of electrical apparatus on railway trains." J. E. Liardet and J. Donnithorne. Dated December 10.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1881.

1543. "Electric lamps." St. George Lane Fox. Dated April 8. 6d. Has reference to incandescence electric lamps. The figure represents a vertical section of a lamp. *a*, *a*, is the flask or globe; *b*, *b*, are the mercury tubes formed with spherical enlargements or bulbs, b^1, b^1, at their lower ends; *d*, is the cotton wool above the mercury in the tubes, *b*, and *e* is the plaster of Paris over the cotton wool; *f*, *f*, are the conducting wires or



terminals; *g*, *g*, are the platinum wires fused into the bottoms, *n*, *n*, of the tubes, *b*, and extending up into the mercury in these tubes; *h*, *h*, are the cylinders or blocks of plumbago or carbon with holes drilled in their upper ends so as to allow of their being forced over the lower ends of the wires, *g*, as shown, the wires being cemented in the cylinders by Indian or Chinese ink; *i*, is the electric bridge, the ends of which are inserted into holes

or slits in the lower ends of the cylinders *h, h*, and they are similarly cemented with Indian or Chinese ink. The ink is applied to the ends of the bridge, *i*, and dabbed round the holes in the cylinders, as seen at *k, k*.

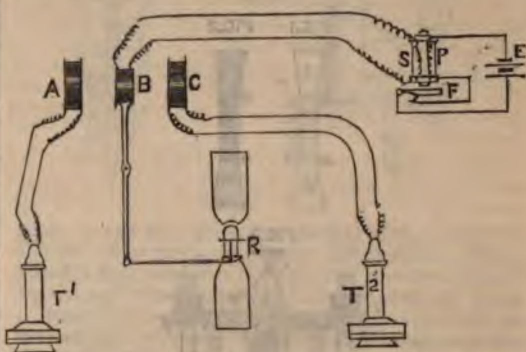
1550. "Protecting magnetic needles from local attraction." JOHN SACHEVERELL GISBORNE. Dated April 9. 6d. The magnetic needle is surrounded with several series of concentric segments, or other suitably shaped pieces of iron, which also extend underneath the needle and meet in the centre as close as possible to the pivot upon which the needle is mounted; these iron segments or other shaped pieces are not in touching contact but are isolated from each other by intervening pieces of ebonite or other suitable insulating material. By thus surrounding the needle it is insured that any polarisation of the iron, even should it occur, shall not affect the magnetic needle, and yet that the needle shall itself be effectually protected from the influence of any local attraction.

1577. "Electric telegraphs," &c. JOHN HOPKINSON and ALEXANDER MUIRHEAD. Dated April 11. 2d. Relates to improved methods of employing dynamo-electric machines for producing the electric currents used in telegraphy, and for other similar purposes. A secondary battery or a series of voltameters, or in some cases a condenser in combination with dynamo-electric machines (sometimes called electro-magnetic or magneto-electric machines) are used to correct the inconvenience sometimes experienced from the self induction of the latter when used alone. (*Provisional only*.)

1596. "Electric lamps." A. W. L. REDDIE. (A communication from abroad by Hermann Sedlaczek and Franz Wiknlill, of Leoben, Austria.) Dated April 12. 6d. Relates to improvements in the means of regulating the feed of the electrodes in that class of lamps in which the holders of the said electrodes are supported on fluid contained in closed vessels communicating with each other at their lower parts. This improved regulation of the feed of the electrodes is effected either by connecting directly or indirectly a centrifugal governor upon the motive power engine with a hollow cock or piston of peculiar construction, whereby the passage of the fluid from one vessel to the other may be perfectly controlled, or by means of a novel arrangement of electro-magnet whereby a piston is caused to operate with great delicacy in controlling the passage of the fluid from one vessel to the other.

1613. "Electrical signalling and tell-tale apparatus for watchmen," &c. W. R. LAKE. (A communication from abroad by Isaac Towle Campbell, of Boston, America.) Dated April 13. 8d. Relates to electric alarm and registering apparatus intended for the use of, and as a guard upon watchmen, to indicate any neglect of duty.

1624. "Electric telegraphs." ALEXANDER MUIRHEAD and HENRY ALFRED CHARLES SAUNDERS. Dated April 13. The object of this invention is to facilitate the reception and retransmission of messages on long submarine cable circuits. A double telephonic repeater is employed in connection with the suspended coil or magnet of the receiving instruments, and there is introduced between one cable and another, automatic translating apparatus operating by light or radiant energy. The double telephonic repeater consists of three independent coils, A, B, and C, as shown in plan by the figure. The middle one, B, is suspended and movable between the other two, A and C. It is connected to the movable coil, R, of a Thomson's recorder and therefore responds to the fluctuations of the cable current in the latter. The other two coils, A and C, of the series are fixed and connected with two separate telephones, T^1 and T^2. A rapid series of currents from a battery, E, is caused to pass through the suspended coil by means of a tuning fork, F, or other make and break arrangement. Sound will be produced in the telephones varying in intensity with the proximity of the suspended coil to the fixed coils. The nearer the suspended coil to either fixed coil the louder will be the sound in the corresponding telephone. The operator placing a telephone to each ear reads by sound the message transmitted. For the sake of lightness the suspended coil, B, is constructed of aluminium wire. For automatic translation between submarine cables an arrangement is employed in which an electrical circuit is affected by radiant energy. Selenium (or other substance whose electrical resistance is affected by radiant energy) is extended into a band, like the scale of a reflecting galvanometer, and the movable index of the receiving instrument controls a beam of light or



heat, and by its motion determines the extent to which the selenium is affected by the beam. Variation of electromotive force proportional to the amount of movement of the index is thus brought about in a circuit in which a relay is included. Two relays of the Brown and Allan type are employed, *i.e.*, relays in which the contact maker moves with the first rise and the first fall of potential. These relays are placed in close circuit with the selenium in the following manner:—One terminal of each relay is connected to the ends of the selenium, and the other terminals are connected to the middle. In the local circuits of these relays are placed electro-magnets and batteries. The contacts made by the relays are employed to actuate translating levers in connection with the cable.

1636. "Apparatus for producing motion by electricity," &c. ST. GEORGE LANE FOX. Dated April 14. 6d. Has special reference to apparatus in which an electrometer or electro-dynamometer connected between the electric mains and the earth is employed to actuate a motor which is caused to control the action of the electric generator or generators, or to control the commutators or secondary batteries, or to control the action of rheostats or resistances, or for other purposes in systems of applying or distributing energy by electricity through mains, submains, and branches for lighting or other purposes. As the electromotive force in the mains rises above or falls below a given limit, the electrometer or electro-dynamometer completes a circuit, and sets up a current through one or other of two contact pegs which are respectively connected with two electro-magnets of the motor.

1653. "Electric lamps." J. H. JOHNSON. (A communication from abroad by the Société La Force et la Lumière Société Générale d'Electricité of Brussels.) Dated April 14. 8d. Has for its object the production

of an electric lamp which shall give light by incandescence, and offer the requisite resistance to the passage of the current without the necessity for the employment of long and very attenuated conductors, and this object is effected by means of the improvements hereinafter described. Fig. 1 is an elevation, and fig. 2 a corresponding longitudinal section of a divided incandescent conductor, constructed according to the said invention, and adapted for use in a lamp from which the air is excluded. Fig. 3 shows the lamp for the conductor, illustrated in figs. 1 and 2. Referring to figs. 1 and 2, *a* is an incandescent conductor divided into a number of sections, *s*, arranged between two supports or contact pieces, A and B, which are caused to exert a certain amount of pressure on the divided conductor, *a*. The conductor, *a*, is composed of a substance or substances of a highly refractory nature, such, for

FIG.1

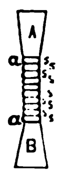
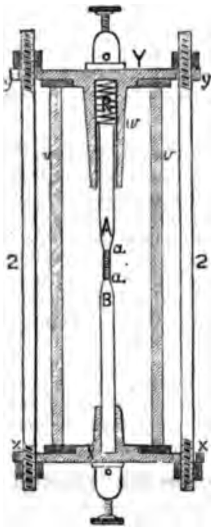


FIG.2

FIG.3



example, as graphite, retort carbon, artificial agglomerated carbon, carbon made from wood, paper, or other calcined organic matter or metals, which are the most difficult of fusion, such as iridium, osmium, ruthenium, and the like. The contact pieces, A and B, are either made of the same materials as the divided conductor, *a*, or of a material of a less refractory nature, such, for example, as platinum.

1670. "Electric lamps." GEORGE SYLVESTER GRIMSTON. Dated April 16. 6d. Relates chiefly to that description of electric lamps in which the regulation of the carbons is effected by the differential action of two coils or solenoids of different resistance, of which the coil of low resistance is in the lamp circuit, while the coil of high resistance is connected to the external circuit only. The soft iron core or cores, which is or are acted upon by the two coils or solenoids above referred to, carries an arm or bracket, through apertures in which passes the carbon holder, which can descend freely through the apertures unless otherwise held. To the bracket is pivotted an excentric or cam-shaped piece provided with a projecting arm, the weight of which tends to turn the excentric or cam so as to press the carbon holder against one side of the apertures through which it passed, and the carbon holder is thus held in the bracket, and can only move up or down with the same, according as the core is actuated by the differential coils. When by the burning away of the carbon, and the consequent increased action of the coil of high resistance, the core has caused the bracket and carbon holder to descend to a certain point, the arm of the cam or excentric comes in contact with a stationary adjustable stop, and the further descent of the bracket consequently causes the cam to be turned, so as to release the carbon holder, which then descends by gravity through the bracket. On the current now passing to a greater extent through the coil of low resistance, consequent on the near approach of the carbons, the core is actuated so as to raise the bracket, and the arm of the cam being now again free to turn the cam so as to nip the carbon holder, this is raised again with the bracket, so as to bring the carbon to the proper distance for producing the electric arc.

1676. "Secondary electric or galvanic batteries." J. H. JOHNSON. (A communication from abroad by Camille Alphonse Faure, of Paris.) Dated April 16. 6d. Relates to improvements in the construction and arrangement of secondary, electric or galvanic batteries constructed on what is known as Faure's system as well as Planté's system, or any other battery of the same class. In carrying out this invention the lead plate acting as the support or the surface of the support is coated or covered in the first place by means of electrotypy, disintegration, or deposit in the form of paste with an active substance or composition, which may consist of either red lead or other oxide of lead or of an insoluble salt of lead, or again of a metallic salt producing the effect desired. This active composition is afterwards covered with felt, cloth, asbestos, cardboard, or paper, canvas, or any other porous material that is not liable to be injured by the use to which it is applied. The object of this porous substance is to maintain the active composition in its place against the support. It is obvious that wire gauze made of lead or other suitable wire may also be employed for this purpose. It then becomes necessary to attach this porous covering employed for holding up the composition to the support, and this is effected by various means according to the nature of the support, that is to say, by means of leaden rivets, or rivets of other suitable material, or material which is not liable to produce objectionable products under the action of the liquid in the battery.

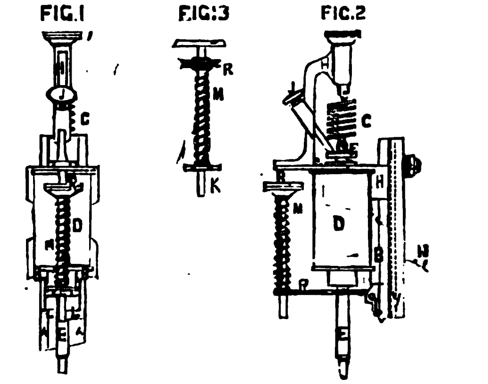
1679. "Telephonic and telegraphic exchange systems," &c. JOHN NORCROSS CULBERTSON and JAMES WALLACE BROWN. Dated April 16. 6d. Has for its object improvements in telephonic and telegraphic exchange systems, and in insulating and mounting the conducting wires used for telephonic and telegraphic communication. In working the telephonic apparatus it has been found desirable to use complete metallic circuits, and endeavours have been made to arrange what are known as central exchange systems to work in this manner, but up to the present time no satisfactory arrangement has been applied for the purpose. This object is effected in the following manner:—Switch boards are employed of the ordinary construction with a number of insulated parallel bars, to which conducting wires leading to the distant stations are attached. At

right angles to these wires are a number of other insulated bars, to which any one or other of the first-mentioned bars can be coupled by the insertion of a metallic peg at a point where the bars cross one another. One of the cross bars of each switch board is ordinarily coupled to earth. All the return wires from the distant stations are connected to this bar, and where a number or series of similar switch boards are used all these bars of the several switch boards are coupled together by a conducting wire. Thus the return circuit from all the distant stations will be conveyed through this wire, and the coupling of the wire from one station to the wire leading to another station will be effected by shifting a single peg only, that is, one peg for each station.

1683. "Electrical apparatus for signalling on railways." A. M. Clark. (A communication from abroad by Augustin d'Auriac, of St. Flour, France.) Dated April 16. 8d. Relates to electrical apparatus for establishing communication between trains in motion and between trains and stations, whereby to prevent collision between two trains running at different speeds upon the same line of rails between two stations. The apparatus is based on the principle that any good conductor of electricity, when in contact with another body traversed by an electric current, will give passage to the current at the instant of contact, and cause it to take another path through a conducting wire suitably arranged. The apparatus carried in a signalling van comprises a battery, a transmitter, and a receiver, and the line conductor is a rail made of three bars of galvanised iron. Upon this rail runs a contact wheel of wood with a metal tyre, which receives the currents traversing the rail and transmits them through a conducting wire to the receiver, the wheel being kept in contact with the rail by a spring at all speeds.

1685. "Electric lamps or regulators." A. M. Clark. (A communication from abroad by Jean Marie Anatole Gerard-Lescuyer, of Paris.) Dated April 18. 8d. Relates to various modifications or arrangements of electric lamps or regulators, in which a small arc is produced for effecting the division of the electric light. In figs. 1 and 2, A, represents a brass or copper guide, upon which slides a bracket or frame, B, C, carrying a solenoid, D, made of fine wire, through which passes freely the brass carbon holder, E, to the upper end of which is fixed a soft iron armature, F. The carbon holder, E, is suspended by a spring, G, from a small bracket, H, carried on the plate, C, so that the armature is a few millimetres above the upper pole of the solenoid. The tension of the spring may be regulated by a screw, I, and the distance between the armature, F, and the pole of the solenoid is regulated by a screw, J, mounted obliquely. At the lower end of the sliding bracket, B, a second armature, K, is pivotted, and has a short arm, or jaw, L, which is caused by the pressure of a spring, M, on the end of the arm, K, to bind against the guide, A, the stress of the spring, M, being regulated by a screw, R. The upper carbon is fixed in the carbon holder, E, and passes between guide rollers, s, by which it is electrically connected with the lamp frame, so as to reduce the length of carbon traversed by the current The lower carbon, of much larger diameter than the upper one, is fixed in line therewith. This carbon is consumed very slowly, and needs readjustment only when the upper carbon has been entirely consumed. It is fixed in a clip or holder, S[1], carried by an arm, O, insulated from the lamp frame. The solenoid, D, is placed in derivation by means of a spring, shown in dotted lines, sliding in contact with a plate, y, fixed in the groove, X, insulated from the body of the lamp, and connected with the arm, O. The action is as follows:—The current enters at N, and the carbons being separated passes by the derivation through the wire of the solenoid, D, excites it, and causes the armature, K, F, to be attracted. The oscillation of the armature, F, releases the grip of jaw, L, and allows bracket, B, to descend. As soon as the carbons come in contact the current passes through them, the coil, D, becomes inert, and the two armatures are withdrawn by their springs, the one causing the jaw, L, to again bind against the

FIG. 1 FIG. 3 FIG. 2



guide, A, and thus arrest the descent of the bracket, B, and the other causing the upper carbon to be suddenly raised or separated from the lower one, thereby establishing the arc, whose amplitude is regulated by the screw, J. Should the resistance of the arc become too high, the current again traverses the coil, D, and the upper carbon slowly descends. The feeding of the carbon is effected by continuous and insensible vibrations without jerks, so that the light is constant. In order to increase the effect of these vibrations, a pallet may be mounted on the armature, K, having small knobs of metal on its ends, as shown in fig. 3. This regulator may also be inverted, if desired, and two or more may be combined in a single lamp.

1696. "Telegraphy." Sydney Pitt. (A communication from abroad by Orazio Lugo, of New York.) Dated April 19. 6d. Has for its object so to organise

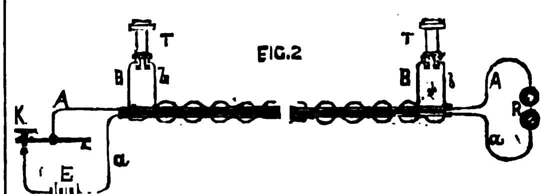


FIG. 2

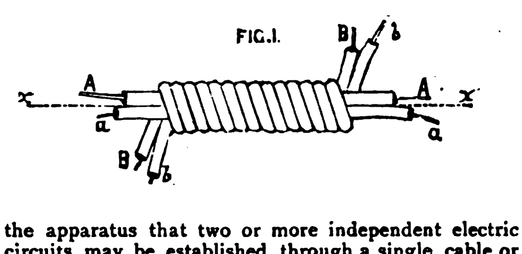


FIG. 1.

the apparatus that two or more independent electric circuits may be established through a single cable or compound conductor, each of which may be utilised for work independent of the others, so that electric currents of different character or independent sets of signals may be simultaneously sent through the same compound

conductor. Fig. 1 represents the organisation of conductors forming two telegraph or telephonic circuits organised in accordance with the principles of this invention, and fig. 2 is a theoretical diagram illustrating the application of the invention to a telegraphic and a telephonic circuit. Two metallic conductors, A and *a*, are shown in fig. 1, each enveloped in the ordinary manner in insulated coatings of any suitable material, which are placed parallel to and symmetrically disposed on opposite sides of the line, *x*, *x*. Two other similar insulated conductors, B and *b*, are wound helically and as closely as possible around the conductors, A and *a*, the line, *x*, *x*, forming the axis of the helices. Thus the direction of electric currents traversing the conductors, B, *b*, will be nearly perpendicular to the direction of currents traversing the conductors, A, *a*. If the directions of the two sets of conductors were exactly perpendicular to each other, it would be impossible for any inductive effect to take place between them. Fig. 2 represents the organisation of telephonic and telegraphic apparatus which it is preferred to use in connection with this invention. E represents the battery, K the telegraphic transmitting key, and R the corresponding receiving instrument at the opposite terminal station. This organisation of apparatus and conductors constitutes a metallic circuit. T and T' in like manner represent two telephones adapted for sending or receiving, placed at opposite terminal stations, and included in the metallic circuit formed by the direct and return conductors, B and *b*.

1745. "Electrical batteries." C. D. ABEL. (A communication from abroad by Paul Jablochkoff, of the Société Générale d'Electricité (procédés Jablochkoff), of Paris.) Dated April 22. 6d. Relates to an improved construction of electrical battery, which has for its object to accumulate electricity and which operates according to the principle of the secondary batteries. The invention consists in rendering the electrodes, whatever their nature and form may be, more apt to become polarised by covering them with oil or other fatty, oleaginous, or resinous bodies, in particular the hydrocarbons and mineral oils, such as naphtha and its compounds. (*Provisional only.*)

1762. "Preparation of materials for electric insulation." JOHN AMBROSE FLEMING. Dated April 23. 6d. Relates to improvements in the preparation of materials to be employed for the purposes of electric insulation, whereby advantages in economy and facility of production are obtained. In carrying out the invention, there is taken the best quality of wood of various descriptions which has been treated in such a manner as to remove from it water and all acids, and melted paraffin wax is then forced into the wood under pressure. The paraffin wax solidifies in the fibre, and converts the wood from a moderate conductor into a nearly perfect non-conductor, the wood not being simply immersed in the paraffin, but impregnated with it into the interior of the wood.

1770. "Receiving and transmitting apparatus of printing telegraphs." W. J. BURNSIDE. Dated April 23. 2d. Relates especially to that class of printing telegraphs which are designed to be operated automatically by means of electric pulsations proceeding from a suitable transmitter situated at a point more or less distant. The general object of the invention is to increase the rapidity and certainty of operation of such an apparatus, and to provide improved means of maintaining the synchronism between the transmitting cylinder at the sending station and the type wheel at the receiving station or stations. (*Provisional only.*)

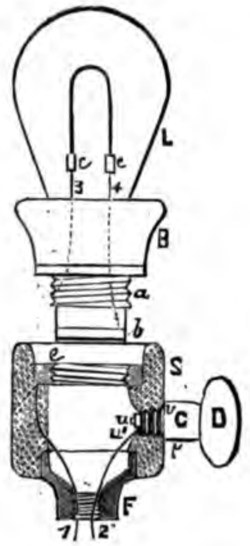
1783. "Measuring electric currents." E. G. BREWER. (A communication from abroad by Thomas Alva Edison.) Dated April 25. 6d. Relates to a current measuring apparatus in which there is used as the basis of the meter a simple electro deposition cell placed in a shunt to the main circuit, so arranged, that only a definite fraction of the entire current shall pass therethrough, which may be effected by placing a suitable resistance in the main conductor, at a point between the unions of the conductors of the shunt circuit thereto. At stated intervals the cathode plate is taken from the cell and weighed, the increase in result indicating the amount of current which has passed therethrough, which, multiplied by the denominator of the fraction representing the portion of current shunted, gives the amount consumed in the entire circuit to be measured. Upon the passage of the current through the cell, the fluid therein is heated, it may be to a very small extent, still there is a heating effect therein. This diminishes the resistance of the cell, and consequently a proportionately increased amount of current passes therethrough, making an appreciable source of error. To remedy this, a resistance should be used in the cell circuit, equally susceptible to the heating influences of the current, but which increases in resistance as it is heated. By this means, as the resistance of the cell is diminished, the artificial resistance in its circuit is increased, so that the entire resistance of the shunt or electro-depositing circuit is maintained constant. A resistance of fine copper wire answers well for this purpose.

1787. "Dynamo-electric machines." A. M. CLARK. (A communication from abroad by Hans Jacob Müller and Alexander Levett, of New York.) Dated April 25. 1s. 4d. The chief object of this invention is to provide a new and improved dynamo-electric machine, which is so constructed that a series of separate and independent currents can be produced, of which one may be used to excite the field magnets, and at the same time perform work in the external circuits, whereas the other currents perform work in the external circuits only, and these different currents from the same machine may be of various degrees of intensity.

1802. "Electric lights," &c. PETER JENSEN. (A communication from abroad by Thomas Alva Edison.) Dated April 26. 10d. In a system of electric lighting, where the lamps used consist of an incandescent conductor hermetically sealed in a glass inclosing globe, it is desirable that the lamp and its supporting socket should be so constructed that the lamp may be readily removed from or placed in the socket, and that at the same time by the act of placing in or removing the lamp from the socket the appropriate circuit connections to the conductor, subject however and only to the control of a suitable circuit controller for throwing the current through the lamp when desired, shall be completed.

In the figure, which shows the invention by which this requirement is accomplished, S is the socket, made of insulating material hollowed out to receive the neck, B, of lamp, L. The socket is provided with the screw threaded end, F, made of a separate piece attached to the socket, or made integral with the socket, for attachment to any suitable support or fixture. Secured in the socket is the circuit controller, C, formed as follows:—*t*, its stem, is a cylinder of insulating material, screw threaded at one end, *v*, for its securement to S. The outer end of the cylinder is a head, *o'*, solid, except for an aperture, through which passes the rod, *x*, carrying the contact point, *u*. Upon the rod, *x*, is a head or washer, *u'*, filling the inner end of the cavity in *t*, and forming a bearing, against which takes the spring, *s*, wound around *x*, and serving to force *u*, *u'*, out from *t*. Upon the head, *o'*, of *t*, are cut the diametrical grooves,

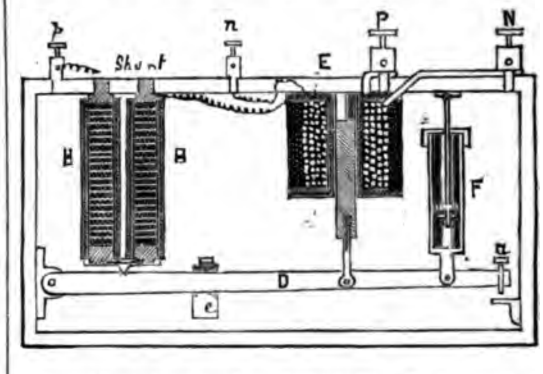
E, E', of which one, E, is much deeper than the other, as shown, both having inclined or bevelled sides. A pin, y, attached to and extending out from, x, takes in these grooves. Upon its extreme outer end the rod, x, should be provided with an insulating thumb piece, D. From this it will be seen that as D is turned the stress of the spring, z, pulls y into one of the grooves, and holds it there, unless force be applied sufficient to raise it therefrom, so that when the pin, y, falls into E, the



extra depth thereof permits the spring to force u out further than when the pin takes in E[1]; and these distances are so proportioned that when the pin, y, is in E, the circuit shall be closed, and broken when the pin, y, is in E'. Two metal bands or rings, a, b, are put upon the neck, B, one of which, a, is formed into a male screw thread; from these bands, wires, 3, 4, lead to the clamps, c, c, of the incandescing material. Upon the interior of the socket is the metal band, e, formed into a female screw thread, to which is connected the main conductor, 1, the other main conductor, 2, being connected to, c. The act of placing B within S, and fastening it therein by the screws, a, e, completes also the circuit connections, one branch then being, 1 . e . a, 3 . c, the other being, 2 . C . b, 4 . c.

1826. "Galvanic soles for shoes and boots." G. W. VON NAWROCKI. (A communication from August Wienand, of Pforzheim, Germany.) Dated April 27. 4d. The soles are mainly composed of alternate strips or pieces of zinc and copper united by brass eyelets. Applied as a "sock" to be placed inside a boot or shoe, the underside is covered with leather, and the upper side with woollen material. The metal parts are united to the leather part by means of eyelets, rendering the sole or sock durable, and facilitating the exhalation of vapours from the wearer's foot. The acid animal exhalations produce with the zinc and copper parts a gentle electric current, which is of great value in rheumatic affections. Instead of copper and zinc, other substances of opposite electric or galvanic properties may be used.

1835. "Current-governors for dynamo-electric machines." H. J. HADDAN. (A communication from abroad by Charles F. Brush, of America.) Dated April 28. 6d. Relates to dynamo-electric machines, and has for its object the adaptation of such machines to variable external conditions without variation of the speed at which their armatures are rotated, but by variation of the intensity of the magnetic field, and this by means not directly depending on the volume of current circulating in the external circuit. In the figure, H, H, are piles of carbon or other suitable plates inclosed loosely within glass, porcelain, or other suitable insulating tubes or supports. The piles rest upon blocks of carbon or metal electrically connected, carried by a bar of wood or metal, which is pivotted to and supported by the lever, D. The upper ends of the insulating tubes are loosely closed by plugs of carbon or metal supported by the frame of the apparatus and insulated from each other. The tubes or supports inclosing the piles, H, may be of metal (to absorb and radiate the heat generated) lined with mica or other insulator. The magnet-helix, E, consists of two separate coils of wire, one located in the shunt circuit, the other in the main circuit, both as shown. These two coils or helices may be arranged in various manners in relation to each other. Either may occupy the outer position or may cover exclusively one line of the spool. Two compound helices, E, with corresponding cores of iron may be employed to increase the effect. Within the helix, E, is a movable iron core pivotted to the lever, D. This lever pivotted at one end, as shown, also carries a movable and therefore adjustable weight, c. (An



adjustable spring may be substituted.) The free end of the lever, D, also carries the body of a dash-pot, F, and a thumb-screw, d, by which the downward movement of the lever is adjusted. The piston of the dash-pot, F, is attached to the frame-work of the apparatus by means of its rod, as shown, and is provided with a valve opening downward. When the dash-pot is filled with glycerine or other suitable liquid its piston and valve allow the lever, D, to move downward freely but retard its upward movement. The valve in the piston is not essential, but is desirable, as will be shown later. The operation of the whole device is as follows:—The binding-posts, p, n, forming the terminals of the shunt circuit, are connected with the field-magnets of a dynamo-electric machine in the manner explained in the previous letters patent referred to. The course of the shunt-current is then from the post, p, through to the piles, H, H, outer portion of helix, E, to post, n. The binding-posts, P, N, are put in the main or working circuit of the machine, as was also explained in the said prior patent, but in such a manner that the main current shall pass through the helix, E, in the same direction as the shunt-current. The weight, c, is so adjusted that when the machine is working to its full capacity and the normal working-current is passing through its portion of the helix, E, the inclosed iron core, lifted by the axial magnetism developed in the helix, shall just sustain the lever, D, and parts con-

nected therewith while subjecting the piles, H, to little or no pressure. Since in this condition of affairs the piles, H, H, perform no function, the circuit through them may be entirely broken by dropping the lever, D, sufficiently. This however is not essential. The office of the thumb-screw, *d*, is now apparent. If now the resistance of the working circuit of the dynamo machine be lessened from any cause the current will be correspondingly increased in the helix, E, and the inclosed core will be drawn upward, raising the lever, D, and subjecting the resistance-piles, H, to a pressure corresponding to the increase of current in the main circuit. Current will then be shunted from the field-magnets of the dynamo machine until the main current is reduced to nearly its original strength. Some increase of current strength is, however, required in order to maintain a suitable pressure in the piles, H, H. It is in order to render this necessary excess of main current as small as possible that the shunted current is made to pass through a portion of the helix, E. The shunted current thus assists in maintaining a suitable pressure on the resistance piles, H, H, and the apparatus is thereby enabled to respond to very much smaller variations in the strength of the main current than it otherwise could do. When the carbon piles, H, H, are subjected to pressure, their conducting power increases less rapidly than the pressure applied. Hence the apparatus is not liable to get into the condition of "unstable equilibrium." The office of the dash-pot, F, has already been described, but the function of the valve in its piston has not been indicated. Suppose a number of voltaic arc lamps are operated in the main circuit, and the latter, as often occurs in practice, becomes for an instant broken, then, owing to the valve in the piston-rod of the dash-pot, the lever, D, drops at once, and the shunt resistance increases, so that when the carbons in the lamps have come together and completed the main circuit again the full power of the dynamo machine will be available to separate the carbons in the lamps, and owing to the slow upward motion of the lever, D, allowed by the dash-pot sufficient time is given for the carbons in the lamps to become fully separated before the shunt can act; but if the lever, D, had not been allowed to fall materially during the instant the main circuit was broken the abnormally great current developed when the circuit was closed, and before the carbons in the lamps had time to separate, would further raise the lever, D, and unfit the dynamo machine for developing its normal current. An appreciable length of time would then be required for the resistance apparatus and the lamps to again adjust themselves. Again, if the resistance of the main circuit is suddenly increased, the valve in the dash-pot allows the lever, D, to fall at once, and thus the dynamo-machine is quickly adapted to the new condition of circuit.

1873. "Telegraph cables," &c. W. T. Henley. Dated April 30. 6d. According to this invention, combined conductors are constructed for telephonic, telegraphic, and other purposes as hereinafter described, by which means additional strength and security is obtained, and the disturbing effects produced by induction from wire to wire, obviated. The wires are insulated with any suitable material, but preferably with "ozokerited" india-rubber. The wires are inclosed by means of rollers or dies in the insulating material in pairs, or any further number, as shown by the figures. Fig. 1 shows a single pair; fig. 2, three pairs united, the spaces between each pair being greater than between the wires of each pair; this is to prevent the induction when using the metallic circuit for telephone purposes. To obtain tensile strength, one wire of each pair is made of steel, by preference galvanised or zinc coated; this should be as much larger than the copper wire in same circuit as its electrical resistance is greater, so that the electrical conductivity of the pair of wires, steel and copper, should be as nearly as possible equal. Fig. 1 shows a pair of wires thus constructed. When laid underground in pipes or troughs, the wires may be all copper, and a number be combined in a trough, as in fig. 5, where one hundred wires are shown in a wooden trough covered with an iron lid, forming one hundred separate telegraphic circuits, as the metallic circuit is not required for the telegraph, neither does the induction interfere, as the

FIG. 1.

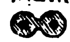


FIG. 2

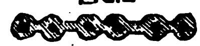


FIG. 4

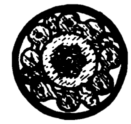


FIG. 3

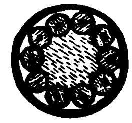
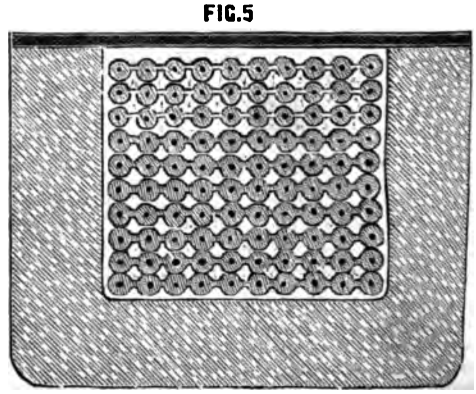


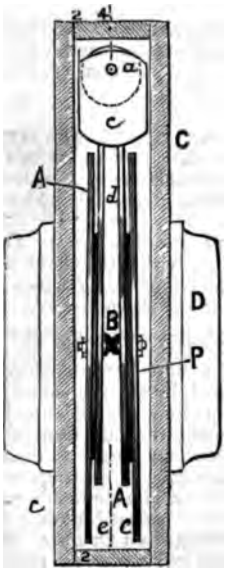
FIG. 5



telegraph instruments are not so sensitive as the telephone. Fig. 4 shows some of the twin circuits for the telephone, laid up spirally round a central steel strand covered with yarn, and each pair is kept farther apart by an intervening tarred cord. Fig. 5 shows the wires of copper and steel insulated, laid up in pairs round a central core of hemp or other suitable material. In this case the insulated steel wires, whilst forming part of the circuit, give the necessary tensile strength without the central steel strand.

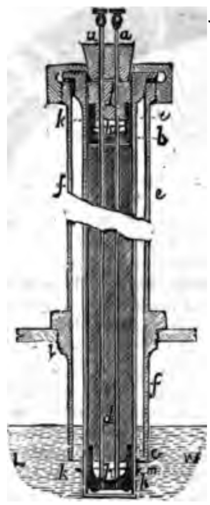
1885. "Electric telephones." William Main, of America. Dated May 2. 6d. Relates chiefly to battery transmitting telephones, but it is also in part applicable to receiving telephones. Its object is to secure the accurate and faithful transmission and reproduction of vocal sounds, even those which are faint and distant, without change of tone, and without transmitting also the external rumblings and inaudible vibrations which frequently occur coincidently with speech. In the figure A, A, are two "acoustic-vibrators," which answer to the diaphragm in other telephones, but differ therefrom in being freely suspended from above, leaving their other edges free to vibrate. Both are hinged to a rod or axis, *a*, whose ends rest in non-

vibratory cushions of felt or rubber; *c*, *c*, are weights of lead or other heavy metal hung on the rod, *a*. Each acoustic-vibrator, A, is constructed of two thin light boards or plates, *d* and *e*, of resonant wood, the plate, *d*, being hinged at its upper edge to the rod, *a*, and the plate, *e*, being borne by the plate, *d*, through the medium of a thin wooden ring, *f*, which separates them slightly, so that a thin layer of air is confined between them. The plate, *d*, has a central sound-opening, *g*, communicating with the air-space. B, B, are the resistance-varying contacts or electrodes, one being fastened to each plate, *e*, so that the two project toward each other through the openings, *g*, *g*. These electrodes



are long enough to separate the acoustic-vibrator slightly so that the tendency of the vibrators to hang directly beneath the axis, *a*, causes them to press the electrodes lightly but firmly together. This pressure remains always uniform, requiring no adjustment. The electrodes are by preference made of platina and carbon respectively, but other substances may be used. They are connected by wires, *i* and *j*, to the local battery and induction-coil in the usual way.

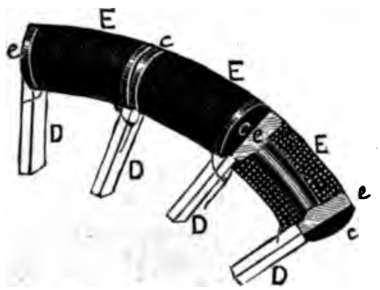
1953. "Electric apparatus for signalling the lowest height of water level, and maximum temperature in steam boilers." CARL PIEPER. (A communication from Richard Schwartzkopff, of Berlin.) Dated May 5. 6d. Consists in an apparatus by means of which an electric current is established for the purpose of giving a signal or of causing any other suitable effect when the lowest admissible water-level or a certain maximum temperature, resulting either from an excess of pressure or from retarded ebullition, occurs in a steam-boiler, the electric contact being made by the melting of an easily fusible metal. The apparatus presented by the figure consists of two metal tubes, *e* and *f*, of different diameter, the narrower tube, *e*, being inserted concentrically into the wider tube, *f*. Both tubes are so connected together at their upper end that the annular space between them is hermetically closed at the top, whereas the inside tube, *e*, which should project with its lower end from the outside tube, *f*, is closed at the bottom. The tube, *f*, is fixed in such a manner in the crown of the boiler that its lower edge is at the height of the lowest admissible water-level, L, W. Its length outside of the boiler must be such as to allow its upper end to remain comparatively cool, four feet being ordinarily sufficient for this purpose. Within the inside tube, *e*, there are two insulated conducting wires or thin rod, *a*, *a*, by preference of copper, which carry two cups or hollow discs, *b* and b^1, of porcelain or other suitable insulating material, the cup, *b*, being near the bottom of the tube, and the cup, b^1, near its top. Each of these cups is placed in a metal ring, *k*, somewhat longer than the cup, so as to form a projecting rim of the same. The wires traverse the upper cup and pass into the lower one, which is fixed to their ends. For the purpose of preventing the wires from touching each other, and the tube, *e*, they are conducted through a cylinder, *d*, and a plug, d^1, made of wood or other insulatiug material. The outer end of the wires, *a*, *a*, is connected by means of other wires with an electric battery and an electromagnet, which may be used for operating an alarm-bell or other signalling device, or an arrangement for extinguishing the fire or dropping the grate-bars, &c. Into the metal rings, *k*, forming the rim of the cups or discs, *b*, and b^1, are placed the rings, *c*, and respectively c^1, made of an easy fusible metal or alloy. The point of fusion of the lower ring, *c*, should be slightly higher than the temperature which the water in the boiler has at the maximum degreee of steam pressure allowed,



whereas the upper ring, c^1, must melt by the heat of the steam when at its lowest pressure. These rings are made to fit closely to the rim, *k*, in order to prevent their outer surface from being oxydised. On the inside they may be similarly protected by the end of the cylinder, *d*, and of the plug, d^1. The action of the apparatus is as follows:—While the water-level in the boiler is higher than the lower edge of the tube, *f*, water will be pressed by the steam into the annular space between the two tubes as far up as the air contained in this space permits. The part of the apparatus outside of the boiler being sufficiently long the surrounding air will keep the temperature of its top end considerably below the temperature of the steam when at its lowest degree of pressure. Under normal circumstances the upper ring, c^1, whose point of fusion may be, for instance, at 90° centigrade (194° F.) will, therefore, not melt. But when the water-level sinks below the lower edge of the tube, *f*,

steam will enter into the annular space between *e* and *f*, and by its heat melt the ring. The molten metal flows into the cavity, *h*, of the cup and produces contact between the two wires, *a*, *a*, whereby the electric apparatus is put into operation. When, on the other hand, the steam-pressure, and consequently the temperature of the water, become excessive, the lower ring, *c*, will melt and cause the electric contact between the wires, *a*, *a*, in a similar manner, as in the first case. The same effect is produced by an excess of temperature caused by retarded ebullition.

1961. "Magneto-electric machines." PAGET HIGGS. Dated May 5. 10d. The novelty of this invention consists chiefly in the ring armature whose construction is shown by the figure. This armature is formed of a number of spools; each of the latter consists of a core of iron slightly curved, so that it will conform to the curvature of the ring, and provided at its ends with circular discs, *e*, in which are slots or sockets, *a*, in which the ends of the arms are inserted, the spools being secured on the arms by steel set screws, *b*, *b*. The insulated wire in which the current is to be induced is coiled around these spools, and is connected down radiating arms to the shaft where the currents may be



collected in various ways. It will be seen that the spools so mounted constitute a continuous ring of soft iron covered by a series of coils separated by the ends, *e*, of the spools which project to the outer edge of the covered ring. This projection of the ends of the spools is an important feature, as it enables the iron of the armature to be brought near to the poles of the exciting magnets and prevents the armatures from heating. The solid rings heretofore used have been provided with corresponding projections between the sections of the coils for a similar purpose. It will be found advantageous to insulate the spools from each other and from the radiating arms, so that no currents can be induced in the ring itself. *c* shows a slip of mica or other insulating material between the ends of the spools for this purpose.

City Notes.

Old Broad Street, December 12th, 1881.

THE CONSOLIDATED TELEPHONE CONSTRUCTION AND MAINTENANCE COMPANY, LIMITED.—The Directors of this Company have declared an interim dividend of sixpence per share, free of income tax, payable on the 31st December, 1881. The directors believe they will be in a position to continue to pay regularly quarterly dividends of the same amount, which is equal to 10 per cent. per annum. Their circular to the shareholders states that considerable difficulty attended the first operations of the company owing to the necessary delay in obtaining premises and materials. Temporary premises in Kirby Street, Hatton Garden, were first engaged, but these having been found inadequate in size, large premises in Farringdon Road have been taken, and are being fitted up on an ample scale. It will be practicable, at the new factory, to manufacture besides telephones, electrical apparatus generally, including that for the electric light. The directors look forward to establishing a large manufacturing business. The company are about bringing out a new combination telephone, which it is expected will prove more serviceable and efficient than any instrument yet produced.

BRAZILIAN SUBMARINE TELEGRAPH COMPANY.—The directors announce an interim dividend of 3s. per share, or 6 per cent. per annum, for the quarter ended 30th September last.

THE WEST INDIA AND PANAMA TELEGRAPH COMPANY, LIMITED.—The offices of this Company are removed to Dashwood House, 9, New Broad Street, E.C., where communications should be addressed in future.

THE WESTERN AND BRAZILIAN TELEGRAPH COMPANY, LIMITED, notify that they have opened a station at Maldonado, in Uruguay, for which place messages can be received at 15s. 8d. per word.

POST OFFICE CABLES.—The ss. *Morna*, of the Edinburgh and London Steam Shipping Company, has been chartered by the Post-office authorities (no regular cable ship being available) and fitted with the temporary cable gear which the General Post-office Submarine Department have ready at their depôt for such emergencies. She left her moorings on Friday evening, the 2nd of December, to commence repairs on several cables which have suffered during the late severe weather commencing from October. She goes first to Dartmouth (Guernsey) to lay a new shore end, the cable being broken close in shore. Then to Scilly for repairs, next Arran, renew cable at Rothsay Bay, another at Gareloch, new cable at Shian Ferry, Loch Creran, and then to lay two across the following lochs:—Etive, Loch Creran (independent) and Loch Leven. With over 60 cables to repair and maintain round the coast, it is high time that the Post-office officials should possess a vessel of their own for such purposes, as it is often a very difficult matter to charter a cable ship just when wanted.

DIRECT SPANISH CABLE.—For the repairs to this cable, the breaking down of which, in a heavy gale and in about 100 fathoms of water, we mentioned in our last issue, the India-rubber and Gutta-percha Company have engaged the Great Northern Company's ss. *Œrsted*. She has recently sailed for this purpose, Mr. H. Benest being the engineer in charge of the operations.

THE WLADIWOSTOCK-NAGASAKI CABLE.—The repair of this cable of the Great Northern Telegraph Company is announced.

OTHER TELEGRAPH CABLES INTERRUPTED.—It is announced that the Indo-European Telegraph Company's cables between Bushire and Jask are interrupted, and telegrams for India and countries beyond cannot therefore be accepted by that company's route, or by the Submarine Telegraph Company's route, *via* Turkey. The cable of the Paris and New York Company is interrupted, and telegrams cannot therefore, for the present, be transmitted by that company's route.